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VOL. II.—31ST YEAR.

SYDNEY, SATURDAY, NOVEMBER 18, 1944.

No. 21.

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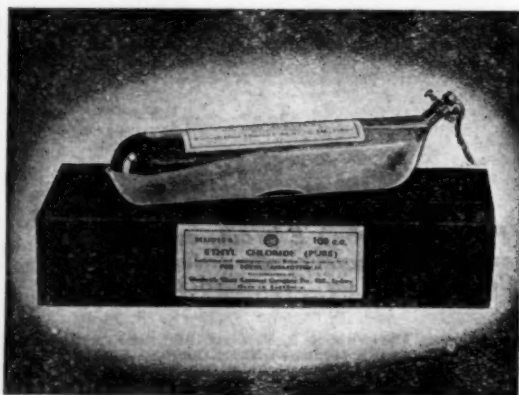
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### MITE-BORNE (SCRUB) TYPHUS IN PAPUA AND THE MANDATED TERRITORY OF NEW GUINEA: REPORT OF 626 CASES.

By S. W. WILLIAMS,

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AND

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(From an Australian General Hospital.)

This report is based on 626 cases of scrub typhus in Australian troops admitted to an Australian general hospital in New Guinea between September, 1942, and the end of September, 1943. Each patient was seen personally by at least one of the authors and close cooperation was maintained between the physician and the pathologist.

Only somewhat brief clinical records of the first group of approximately 300 patients are available, since these were admitted during an extremely busy period. The second group of about 200 patients was studied in more detail and their clinical details were recorded on a history sheet designed for the purpose. The final group of about 100 patients was the subject of detailed clinical and laboratory investigation planned in the light of our earlier observations.

Most of the patients were admitted to this hospital during the early stage of the disease; many were seen right from the onset. This is shown in Table I.

#### DEFINITION.

Mite-borne or "scrub" typhus is a rickettsial disease believed to be transmitted to man by the bite of an

TABLE I.

Days Elapsing from Onset of Time to Admission to Hospital.	Number of Patients.
1 .. .	24
2 .. .	33
3 .. .	56
4 .. .	51
5 .. .	67
6 .. .	52
7 .. .	69
8 to 14 .. .	135
Over 14 .. .	24
Not recorded .. .	115

infected larval trombiculid mite. There is an incubation period of ten to twenty-one days. The classical signs of the disease are a primary sore or "eschar", enlargement of the lymph glands, maculo-papular rash with fever lasting sixteen to twenty days. Proteus OXK agglutinins appear in the blood serum (Well-Felix test). The mortality is very variable, but may be as high as 25%. The disease has been variously named—scrub typhus in Malaya, mite fever in Sumatra, tsutsugamushi fever in Japan, coastal fever in Queensland. However, "scrub typhus" has become firmly established by popular usage amongst the troops and the medical officers, and will be used throughout this paper.

#### GEOGRAPHICAL DISTRIBUTION.

The disease, well known in the Mandated Territory of New Guinea, had been noted in Papua prior to September, 1942, by other Australian medical officers.

The areas of infection, and the number of cases from each, are as shown in Table II. For the purpose of this table a man was considered to have contracted his disease in the area in which he was serving fourteen days before the onset of fever.

The Moresby cases occurred within ten miles of the port. In spite of the large number of troops temporarily or permanently in this area, there were only twelve cases.



TABLE II.

Area of Infection.	Number of Cases.
Moresby .. .. .	12
Kokoda Trail to Buna ..	382
Buna .. .. .	32
Gona .. .. .	1
Sanananda .. .. .	1
Dobadura .. .. .	6
Oro Bay .. .. .	25
Wau .. .. .	97
Milne Bay .. .. .	6
Bena Bena .. .. .	6
Nassau Bay .. .. .	8
Francisco River .. .. .	1
Salamaua .. .. .	3
Not recorded .. .. .	46

The Kokoda trail group with 382 cases included all those infections contracted during the fighting along the Moresby-Buna track and around the sago swamps of the approaches to Buna-Gona. These men were already exhausted by campaigning over mountainous country and debilitated by malaria and dysentery. It seems certain that lowered resistance was a decisive factor in the high mortality rate in this group.

After the Buna campaign the living conditions in Gona and Oro Bay improved very considerably, but many cases of scrub typhus continued to occur in the area. Patients have been received from Buna, Gona, Sanananda, Dobadura and Oro Bay. At the time of writing Dobadura is still an important source of infection.

During the campaign in and around Wau 97 patients from this area were admitted to this hospital.

In not all, and sometimes in only a small proportion of the infections contracted outside Moresby and Buna areas, were the patients admitted to this hospital, especially in recent months.

#### CLINICAL PICTURE.

To show the main features of the disease in time sequence, the following composite pictures in four grades of severity are presented.

##### Infection of Moderate Severity.

The infected soldier reports ill at a forward medical unit complaining of headache, fever, malaise, shivers, a short cough and mild frequency and scalding of micturition.

His medical officer at this time is confronted with a pyrexia of obscure origin and of moderate severity, which is regarded, provisionally, as due to malaria; but within the next two days the course of the illness raises doubts on this score. Repeatedly prepared blood films show no parasites. The temperature shows no remission on the following days and the headache and general disturbance steadily increase and do not respond to quinine. The eyeballs are suffused, the tongue is coated, cough is increased and the soldier begins to complain of mild deafness. Apathy and prostration increase, together with headache and neck stiffness. At this stage a more complete search of the body reveals the typical small eschar. The soldier has not noticed particularly its time or manner of coming. The superficial lymph glands show generalized enlargement. Typhus is now strongly suspected, and on the next day the appearance of a mottled rash on the body confirms this suspicion.

The days following show no abatement of the fever. Review of the temperature chart shows a steady rise to 104° F. The temperature is maintained at this level for twelve hours at a time; it then remits two or three degrees with sweats, to rise again in a few hours.

On the tenth day of illness the patient lies, miserable and lethargic, yet querulous. His rest is disturbed by troublesome cough, headache and unpleasant dreams that are to merge later into clouding of consciousness and transient delirium.

The superficial and deep tendon reflexes are elicited with difficulty—nerve deafness is now quite apparent. The cerebro-

spinal fluid pressure is over 200 millimetres of cerebro-spinal fluid. The pulse rate varies about 100 per minute and the rhythm is regular. The cardiac apex beat is not displaced to palpation and a soft non-conducted systolic murmur is present. Softened heart sounds are associated with a falling systolic and diastolic blood pressure. Respiration is hurried with quick response to the slightest effort, and râles and rhonchi are to be heard in profusion at the lung bases. The sputum is frothy, non-purulent and tinged with blood. Upper abdominal distension and frequent loose motions are present. The fluid balance of the patient is satisfactory. Frequent examinations of the urine show the transient presence of albumin and urobilin. The blood urea content is normal. The closing days of the second week are anxious ones for the medical officer, but for the patient the days and nights merge into the cloudy unreality of delirium. As circulatory and respiratory embarrassment ensues, the patient assumes a dusky suffused hue and the skin over the sacrum and ankles pits with pressure. By now the rash is fading, but the eschar is a deep characteristic ulcer. Deep and superficial reflexes cannot be elicited, and the cerebro-spinal fluid pressure is still raised. Occasional incontinence of faeces and retention of urine and the risk of rapid development of bed sores add to the nursing difficulties. The blood pressure is found to be as low as 80 millimetres of mercury, systolic, and 40, diastolic, the pulse rate increases to 130 per minute, and the respirations are difficult and shallow at 30 to 40 per minute. However, there are still no signs in the chest to indicate any substantial mass of consolidation. Hyalogram casts as well as albumin are now found in the urine and the blood urea content has risen to 60 milligrammes per centum. It is at this stage that the Proteus OXK agglutinins reach a diagnostic titre in the blood serum (Weil-Felix reaction).

In the third week the fever drops by lysis with drenching sweats and steady improvement commences. The patient's colour becomes healthier, the chest signs disappear, and the blood pressure rises with parallel return to normal of the pulse and respiration. The mental and neurological abnormalities disappear. The oedema subsides, leaving the patient wasted. As he begins to move about in the bed, he becomes aware of the profound weakness which is to last for two or three weeks.

Six weeks after the onset of infection, the patient still has some glandular enlargement, but is otherwise well. He has walked reasonable distances without distress and is fit for discharge to a convalescent depot.

At the end of twelve weeks he is well enough to be sent back to active duty with his unit.

Thus may be described a typical severe but non-fatal case.

##### A Fatal Infection.

In those that succumb, the signs and symptoms at the end of the second week are present in severe degree and the march of signs is quickened. In the twenty-four hours preceding death, which is commonly between the twelfth and sixteenth days, the patient is cyanosed, oedematous, with cold extremities, thready pulse and falling blood pressure, the breathing may be periodic or "Cheyne-Stokes" and the patient dies after some hours of coma.

##### A Mild Infection.

A different picture is presented by the patient with mild scrub typhus. The onset is the same and the diagnosis can be made on the presence of glandular enlargement, rash, eschar, and positive reaction to the agglutination test. The course of the fever is basically the same, but less severe. The difference lies in the absence or insignificance of neurological or mental changes, the maintenance of a normal blood pressure, the absence of oedema and cyanosis and the fact that the lung signs are limited to transient basal rhonchi. In such a case the patient may be quite well at the end of three weeks and fit for duty after six or eight weeks.

##### A Case in an Ambulatory Patient.

A few instances have occurred in which the patient has not been sufficiently ill to take to his bed in the course



of the illness, but a positive result to the agglutination test has indicated that he probably had scrub typhus. In some of these mild cases no eschar, no significant glandular enlargement and no rash were present.

#### Typical Case Histories.

Typical case histories illustrating the various grades of severity of the disease follow.

#### Severe Infection with Recovery.

CASE I.—Private W. had been six weeks in New Guinea in the Wau area on a construction job. His illness commenced with severe headache, shivers and sweating, backache and malaise. There was some cough with sputum. On his admission to this hospital on the seventh day of illness his eyes were congested, his tongue was dry and coated and the fauces were injected. There was an eschar in the left scapular region which the patient had noticed about seven days prior to the onset of symptoms. The axillary and inguinal glands were easily palpable. Numerous rhonchi were to be heard all over the lung fields. The spleen was palpable. The deep reflexes were depressed in the lower limbs.

The patient had a continuous fever of 100° to 103° F. for the next seven days. On the twelfth day of illness the patient became cyanosed, distended and oedematous in the lower extremity, and the blood pressure fell from 120 millimetres of mercury, systolic, and 76, diastolic, on admission to 92 millimetres, systolic, and 68, diastolic. He was irrational at night. On the fifteenth day of illness mild transient deafness was recorded, and on the sixteenth day of illness the Well-Felix reaction was obtained with a titre greater than one in 250.

Urine was clear microscopically; the blood urea content was 49 milligrammes per centum. Repeatedly prepared blood films showed no malarial parasites. After the sixteenth day he gradually recovered, and it was possible to evacuate him as a lying patient after twenty days in hospital.

#### Severe Infection: Fatal.

CASE II.—Captain E., aged forty years, contracted scrub typhus whilst on signal line construction near Morobe. Seven days prior to his admission to hospital he had abdominal pain and retroorbital headache and was given two days' treatment at a forward medical post, but in order to reach medical air transport he had to walk forty miles through the jungle. On admission to hospital he was dehydrated and dusky in colour, and his temperature was 101° F. He had a typical large eschar with necrotic scab in the right iliac fossa and a rash on the abdomen; the axillary and inguinal glands were enlarged. His condition deteriorated steadily and rales and later a pleural friction rub developed in the chest; the systolic pressure fell to 90 millimetres of mercury, he became distended, oedematous and stuporose, and died on the seventeenth day of disease without abatement of the fever. The Well-Felix reaction was obtained with a titre of one in 500.

#### Mild Illness.

CASE III.—Private S. contracted scrub typhus on the Kokoda trail near Port Moresby. Symptoms at the onset were pain behind the eyes, cold shivers and general malaise. There was an eschar in the left axilla together with much enlargement of axillary and inguinal lymph glands. A maculo-papular rash appeared on the fifth day of illness. The patient's temperature on admission was 104° F.; this persisted for twelve days. The chest remained clear and there were no signs of circulatory upset. Blood pressure fell from 140 millimetres of mercury, systolic, and 80 millimetres, diastolic, on admission to 105 and 60 millimetres respectively at its lowest. The patient was out of bed on the twentieth day.

#### An Infection in an Ambulant Patient.

CASE IV.—Private P. was admitted to hospital as a "walking case" complaining of exhaustion only. Three weeks previously he had noticed mild shivers and malaise, but continued working. On admission he had a temperature of 101° F., which subsided in two days. There was a small healed eschar on the inside of the right arm. There was no other evidence of systemic disease. Well-Felix agglutination was 1/250.

#### Well-Felix Reaction.

The sera from 582 cases of scrub typhus were tested for Proteus OXK agglutinins.

#### Technique of the Test.

**Serum.**—Serum was obtained from venous blood collected in the usual way. Two routines were followed. (a) Routine diagnosis. In the large majority of cases, blood was collected at the end of the first and second weeks respectively and again, if the diagnosis was still unsettled, at the end of the third week. The reasons for the selection of these times will be given later. (b) Detailed investigation. In twenty-five cases, blood was taken as often as every second day in the acute phase of the illness and then every week during convalescence; in this way the rise and fall of the proteus agglutinins could be studied in detail over a period up to eighty days from the onset of the illness.

Before the test was made, the sera were heated to 56° C. for twenty minutes.

**Proteus Suspension.**—Some difficulty was encountered at first in finding a suitable strain of Proteus OXK, motile and rough variants being common. Finally, a satisfactory non-motile smooth strain was obtained, and since then this strain has been used exclusively. It has been subcultured once a month for the past twelve months without any detectable change in its agglutinability. To prepare the suspension, eighteen hour cultures on agar slopes were washed off with isotonic saline solution, and the washings were heated at 56° C. for two hours and then suitably diluted with isotonic saline solution till they contained approximately five thousand million organisms per cubic centimetre.

This "concentrated suspension" was kept in five cubic centimetre amounts in screw-capped bottles, to each of which two drops of chloroform were added as preservative. In the actual test one drop of this concentrated suspension was added to twenty-four drops of diluted serum in each agglutination tube.

**Test.**—The Dreyer dropping technique was used and serial dilutions of each serum were made. In our routine tests the final dilutions of serum after the addition of the proteus suspension were 1/25, 1/50, 1/125 and 1/250. After incubation in a water bath for eighteen hours at 56° C. the tubes were examined against a dark background under artificial illumination. Only agglutination of the O type, visible to the unaided eye, was recorded. If the titre was greater than 1/250, the test was often repeated, higher dilutions being used, and the exact titre was determined. In many of the routine tests, however, owing to the pressure of work, this could not be done, and in these circumstances the titre was recorded as "> 1/250".

#### Results.

**The Agglutinin Curve.**—The rise in agglutinin titre begins about the ninth or tenth day (the limits in our series being the eighth and thirteenth days) and reaches its maximum about the nineteenth or twentieth (limits fourteenth and twenty-second days). In routine tests we therefore determine the titre on the seventh, fourteenth and, if necessary, the twenty-first days. The seventh day test indicates the patient's preinfection agglutinin level; by the fourteenth day in the majority of cases the agglutinins show a significant increase, whilst the late test on the twenty-first day picks up the occasional patient in whom a rise in titre is delayed or feeble. The maximum titre reached varies widely; the highest figure recorded was 1/50,000.

In the fourth week the agglutinins begin to decrease again. The rate of this decrease is, of course, somewhat variable and it slows down as the titre drops (speaking graphically, the curve "flattens out"), but it may be roughly expressed by the statement that the titre is halved every ten days—that is to say, if it is 1/10,000 at the end of the fourth week, it will be 1/5,000 during the sixth week and so on.

**Value of the Test.**—In diagnosis, as pointed out above, the ideal procedure is to examine the blood both early and late in the disease and so to demonstrate a "significant" increase in antibody titre. We consider that a "two tube increase" is significant, that is to say, an increase from 1/25 to 1/125 or from 1/50 to 1/250.

However, in a number of cases the patients were not seen until late in the second week, so that the initial antibody titre could not be determined. Consequently, when only late tests were made, one was forced to adopt an arbitrary minimum diagnostic titre. The figure finally accepted was 1/125. This figure was, so to speak, "high but safe". It was, perhaps, too high because in 14% of the cases diagnosed confidently as scrub typhus on clinical grounds, there was a titre of less than 1/125 (6% 1/50 and 8% 1/25 or less). It was, however, "safe", because though over 2,000 sera were tested, only one "false positive" was obtained. These sera included normal controls, and specimens from patients with enteric fever due to *Bacillus typhosus*, *Bacillus paratyphosus* A and *Bacillus enteritidis* Gaertner, and from patients with malaria and dengue. One non-typhus patient only, who died of staphylococcal pyæmia, had a titre of 1/125.

The fact that some patients show a very marked antibody response, whilst others develop little or no antibody, may stimulate the query as to whether we are not dealing with more than one disease (the analogy, of course, being the discovery by Fletcher and Lesslar of two types of endemic typhus in Malaya). If this were so, one might expect to find a grouping of cases into those with a high titre and those with a very low titre. A discontinuous variation of this type was not found in the maximum titres of the 25 cases studied in detail. The figures were those shown in Table III.

TABLE III.

Maximum Titre.	Number of Cases.
1/50 .. .. .	3
1/125 .. .. .	5
1/250 .. .. .	3
1/500 .. .. .	3
1/1000 .. .. .	1
1/2500 .. .. .	3
1/5000 .. .. .	3
1/10,000 .. .. .	2
1/25,000 .. .. .	1
1/50,000 .. .. .	1

It has been stated by Gunther that the severity of the symptoms is inversely related to the height of the titre, and that an antibody titre lower than the average figure for the day of disease indicates a bad prognosis. We have found no evidence to support this opinion. Five of twenty patients who died after the fourteenth day gave negative responses to the Well-Felix test, compared with 14% of the whole series. However, apart from this observation which is of doubtful significance, there was no relationship between titre and severity. In some fatal cases high titres were noted; for example, two patients who died on the twelfth and fifteenth day had titres of 1/2,500 and 1/25,000 respectively. On the other hand many of the mild infections induced only a poor antibody response (see Figure IX). In individual cases, therefore, the Well-Felix titre was of no practical help in prognosis.

A "slide agglutination test" was developed by Professor H. K. Ward, University of Sydney, and at his request was used in parallel with the water-bath method in some routine tests. The technique of the test is simple. A drop of suitably diluted serum (we use a dilution of one in four) is placed on a clean microscope slide, and a drop of concentrated proteus suspension is added and mixed by rocking the slide gently for two to three minutes. It is then examined by the naked eye and the agglutination produced by "positive" serum is readily observed. Three hundred sera were tested in this way.

In our hands the results obtained by this method and by the water-bath method were consistent only up to a point. High titre sera (1/500 or higher) always gave a positive result to the slide test, and low titre sera (1/50 or less) always gave a negative result. Sera with intermediate values gave results which were more difficult to interpret, and, unfortunately, many of our sera fell into this range. Nevertheless, there is no doubt that the method is of definite value under conditions where the more elaborate and more exact water-bath test is not feasible.

### Temperature.

On the first day of illness the patient's temperature was usually 99° to 102° F. There was a rise in temperature within twenty-four hours to 100° to 103° F., and during the days that followed the four hourly chart showed a swinging temperature with daily remissions from 99° to 104° F. throughout the illness, subsiding by lysis on the fourteenth to seventeenth days. In more severe cases, for the first three to five days a remittent type of fever was seen, followed by a sustained fever up to 105° F. until recovery or death. In some fatal cases a remittent fever ranging from 99° to 106° F. was recorded during the disease. A temperature which did not rise above 103° F. was seen in a few fatal cases. Table IV shows the number of days of fever in 508 cases, with the number of deaths in relation to the days of fever. (Days of fever were not recorded in 118 cases.)

TABLE IV.

Days of Fever.	Number of Cases.	Number of Deaths.
4	22	—
5	22	—
6	6	—
7	2	—
8	2	2
9	2	—
10	21	—
11	14	4
12	31	4
13	28	4
14	65	6
15	49	9
16	64	9
17	65	2
18	33	2
19	18	3
20	25	2
21	14	1
22	14	3
23	13	—
24	9	1
25	11	1
26	2	—
27	3	—
28	1	1
29	3	—
31	2	—
32	1	—
38	1	—
40	2	2

After the fever had almost subsided, a recording of 99° F. for six to seven days was frequently observed. The highest temperature recorded was 106.5° F. Selected temperature charts are shown (Figures I to VIII).

The patients who had four and five days of fever suffered from mild infections. It will be observed that twelve to eighteen days was the most usual period of fever. In two cases in which death occurred on the fortieth day of fever infected lung infarcts were found at post-mortem examination. A patient with an uncomplicated severe infection had continuous fever for thirty-eight days, but finally recovered. Relapse of fever which could be ascribed to the rickettsial infection was not observed.

### The Eschar or Primary Sore.

The most characteristic feature of these cases of scrub typhus was the primary sore or eschar which was present in 59% of cases. It is presumed that this primary sore is the site of entry of the rickettsial infection.

The patients could seldom give any information as to the origin of the eschar. As a rule they had not particularly noticed the original bite nor the developing eschar. In a few instances the sore was observed by the patient two to seven days prior to the onset of fever.

### Description of Eschar.

At the onset of the disease the eschar was a small rounded or oval sore two to three millimetres in diameter, surrounded by a raised dusky red areola three to four millimetres in width.

There was a firmly attached necrotic centre which developed to a black slough, and this separated usually

about the tenth day, but sometimes remained attached until the twentieth day. After the separation of the slough the eschar had the appearance of a punched-out ulcer. In the groin, perineum and axilla the ulcer was often moist, owing to a small amount of purulent discharge caused by secondary pyogenic infection. In other regions it was usually dry. During the course of the disease the ulcer did not increase in size, but the areola became more prominent and brighter in colour. This areolar development is important in the differentiation of true eschars

# Rash.

A rash was present in 400 cases (65%). It usually commenced between the fifth and eighth days as an eruption of reddish macules which faded on pressure, on the anterior and posterior aspects of the chest and the anterior surface of the abdomen. These macules were two to five millimetres in diameter. In twenty-four hours they became slightly raised to produce a maculo-papular appearance. In forty-eight hours the rash had spread to face, neck, arms, palms of the hands, trunk, thighs, legs and soles of

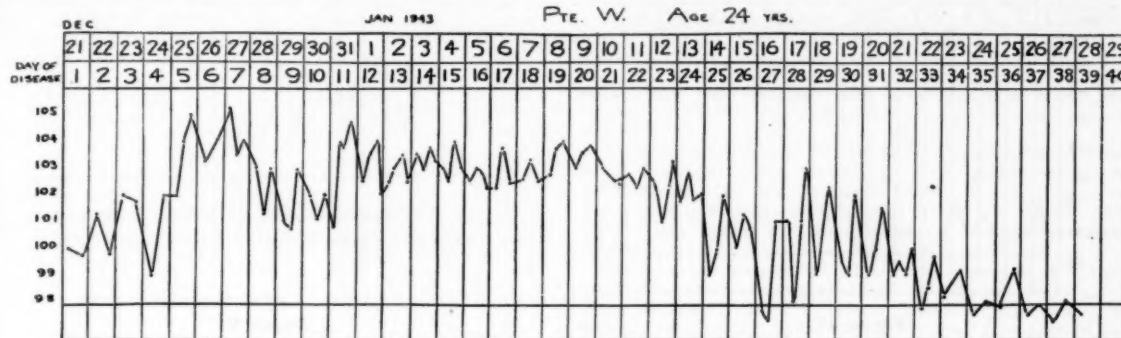


FIGURE I.

from non-specific sores which usually heal within a few days of the patient's admission to hospital. Healing of the eschar occurred in the third and fourth weeks, leaving a pitted scar occasionally pigmented. In one case observed eleven months after the disease the eschar site was still easily visible as a white depressed scar. Larger eschars up to a centimetre in diameter surrounded by an areola 0.5 to 1.0 centimetre in width have been seen. More than one eschar was rarely present. In seven cases there were two, in one case three and in one case six typical eschars. A definite eschar was seen in 349 cases and a probable eschar was seen in 25 cases; these two represent 59% of the total cases.

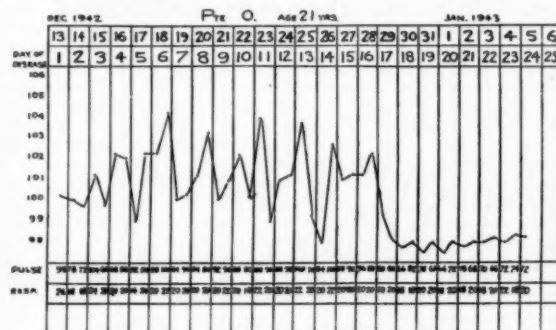


FIGURE II.

## The Eschar Site.

The typhus eschar was seldom seen distal to the knee or elbow and never on the foot or hand. The sites chosen for biting by the infected larval mite were those parts of the body usually covered by clothing. The sites were frequently in skin creases, as in the axilla, groin and perineum. However, this was not invariable, for the eschar was sometimes found on such flat surfaces as the chest, back, outer arm and thigh.

The distribution of the 349 definite eschars was as follows: arm and axilla, 114 (31%); chest and neck, 84 (20%); trunk, 46 (14%); groins, perineum, thighs and buttocks, 99 (27%); popliteal region, 4; scalp, 2.

A photograph of a typical eschar on the tenth day of disease with the rash is shown in Figure XI.

the feet. At this stage the size of the individual spots varied from two millimetres to one centimetre in width. When the rash was fully developed on the third or fourth day the appearance was dull red and prominent, but remained so for only twenty-four to forty-eight hours. It commenced to fade on the fourth to fifth day after its appearance and completely disappeared two to three days later. The rash had usually disappeared by the fourteenth day of the disease, but in a few cases it commenced as late as the fourteenth day and persisted to the eighteenth

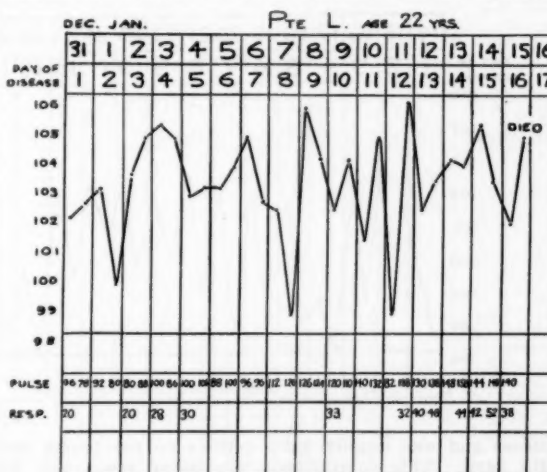


FIGURE III.

day of disease. Desquamation did not occur, but in a few cases marked loss of hair from the scalp was noted. Macules have been observed on the soft palate, but not on the buccal surface of the cheeks or on the pharynx. Apart from these palatal macules, there was no visible evidence of an enanthema.

The rashes seen varied in their intensity and in general the sicker the patient, the more marked the rash.

In some instances rashes of different types were seen. In a few cases the papules were more prominent than in the typical rash, and these spots faded slowly, leaving a slatey appearance which persisted for two weeks.



Occasionally the papular element was absent, and the macules were small and closely packed, though not confluent, presenting an appearance similar to the rashes of measles and dengue.

In two fatal cases the rash commenced in the usual way, but became petechial two days before death in the third week.

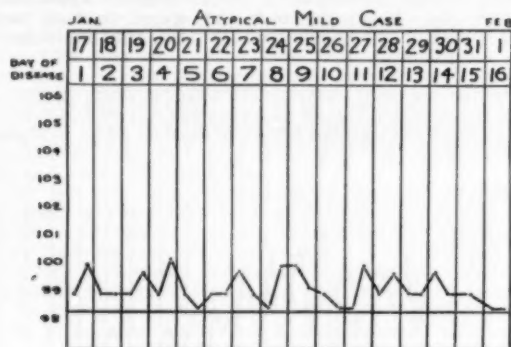


FIGURE IV.

A skin complication unrelated to the rash was a pustular dermatitis, particularly in the axillae and on the back in severe cases. Culture of organisms showed a predominance of *Staphylococcus aureus*.

#### Enlargement of Lymphatic Glands.

Significant enlargement of the lymphatic glands was recorded in 409 patients (66%). Clinical examination showed that those most frequently involved were the axillary and superficial and deep inguinal glands. Cervical and epitrochlear glands were enlarged less frequently. Enlargement could often be detected on the first day of

Microscopically the glands were very congested and the sinuses were filled with macrophages, small round cells and red blood cells.

It was sometimes difficult to assess the significance of the glandular enlargement. Non-specific skin infections

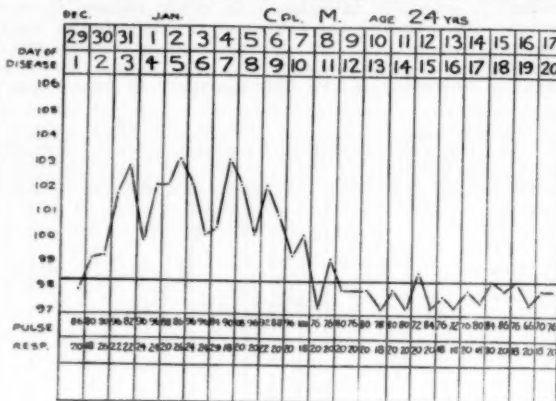


FIGURE VI.

of the limbs caused glandular enlargement which was sometimes difficult to distinguish from that due to a typhus infection. Further, the loss of weight seen in many troops made the palpation of axillary and groin glands easy, giving the impression of enlargement. Dengue fever was another common cause of glandular enlargement.

#### THE SYSTEMS AND ORGANS SEPARATELY CONSIDERED.

##### Circulatory System.

The pulse rate was slower than normally expected with the prevailing fever during the first week, but quickened during the second week to between 90 and 120 per minute.

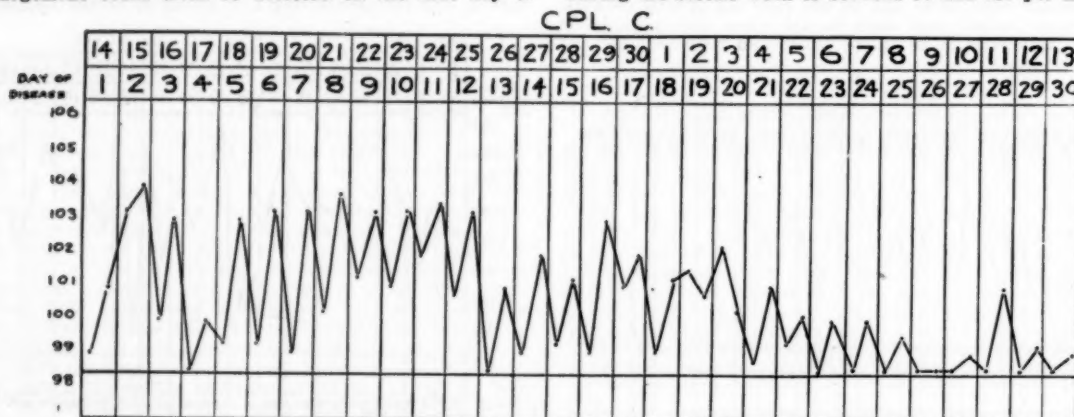


FIGURE V.

disease and was usually quite definite on the fourth and fifth days. This enlargement was never gross, but the glands were easily palpable, firm, elastic and discrete. The glands draining the eschar site were most enlarged, and persisted so during the course of the disease. This glandular enlargement sometimes indicated the site to look especially for the small eschar. Tenderness was not a marked feature unless the eschar was secondarily infected. There was no instance of suppuration of glands in these cases.

Enlargement of glands persisted throughout the illness. During convalescence they subsided slowly and were palpable as long as seventy days after the onset.

In fatal cases, autopsy revealed enlargement of the lymph glands of the thorax and the abdomen, particularly those of the tracheo-bronchial and mesenteric groups.

An unusually rapid pulse was regarded as a serious sign. Five patients with pulse rates over 120 on the sixth day of disease died. In most non-fatal cases the pulse was regular in rhythm throughout, but was often dicrotic in the second and third weeks. In grave and fatal cases the rate increased to between 130 and 160 with the presence of irregularities, due to extrasystoles. *Pulsus alternans* was occasionally observed. On clinical examination the heart was not enlarged and no variation of the position of the apex beat was detected during the course of the disease. In severe cases during the second week, the heart sounds softened, and towards the fourteenth day with tachycardia a tick-tack rhythm was observed. A faint systolic murmur was common. Extrasystoles were not common. Gallop rhythm was noted in two patients, both of whom subsequently died. Electrocardiographic tracings showed no

abnormalities with the exception of one case, in which there was a P-R interval of 0.24 second.

With the subsidence of fever the heart rate soon returned to normal, and during convalescence abnormalities in cardiac signs were uncommon. Tachycardia at rest was observed in nine cases.

At post-mortem examination the heart was nearly always flabby, sometimes markedly so. In a few cases, all chambers were dilated, but the majority were normal in size. Ten showed numerous subpericardial petechial hæmorrhages, particularly in the region of the descending branch of the right coronary artery. One showed a few tiny sub-endocardial hæmorrhages on the septal wall of the left ventricle.

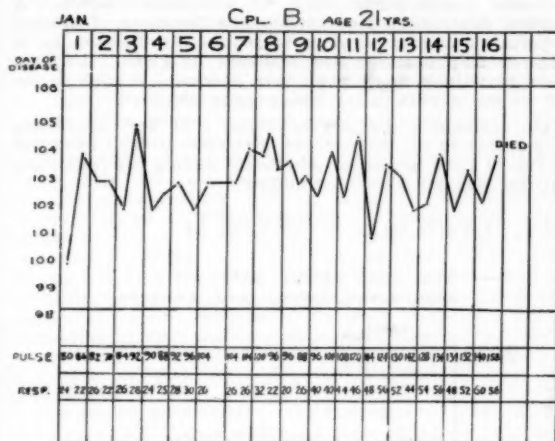


FIGURE VII.

Twenty-four hearts were examined microscopically. Twenty-one of these were from patients who died during the acute phase of the disease—that is, during the second and third weeks. These all showed infiltration by plasma cells, lymphocytes and monocytes. The relatively large number of plasma cells was a constant and striking feature. The inflammatory cells were seen particularly in the sub-endocardial tissue and surrounding the small blood vessels, but were also scattered throughout the heart in between the muscle cells. The cardiac muscle sometimes showed cloudy swelling and loss of striation, but this was not marked or common. No changes were seen in the walls of the blood vessels.

The remaining three hearts which were studied microscopically were from patients who had survived the acute generalized stage, but died later from complications (one at the end of the fourth week and two during the sixth week). These hearts showed no abnormalities. There was no cellular infiltration, nor was there any sign of early fibrotic changes.

Arterial blood pressure was not abnormal in mild cases. During the second week in severe cases the blood pressure commenced to fall, and the daily reading was usually 100 to 80 millimetres of mercury, systolic pressure, and 60 to 35 millimetres, diastolic. However, we have observed fatal cases in which the blood pressure never fell below 100 millimetres of mercury, systolic, and 65, diastolic, until a few hours before death. Other patients with a pressure of 75 millimetres, systolic, and 30 millimetres, diastolic, have recovered. In severe cases blood pressure was restored to normal in ten to fourteen days after the fall in temperature.

Case V was a severe and fatal case which occurred in the Moresby area.

CASE V.—Lieutenant S. contracted scrub typhus whilst on manoeuvres within twelve miles of Moresby. He had in addition contracted malaria during the period of incubation and was admitted to hospital five days after the onset of fever with retroorbital pain and malaise. A doubtful eschar was present in the right side of the upper part of the abdomen; the axillary and inguinal glands were enlarged

and tender and the conjunctivæ were congested. On the seventh day of illness the patient became drowsy and numerous moist sounds were heard in the chest. The systolic blood pressure was 145 and the diastolic pressure was 85 millimetres of mercury. On the ninth day the heart action became rapid and weak and the blood pressure commenced to fall (126 millimetres of mercury, systolic, and 76, diastolic). The following day respirations numbered 40 in the minute, but there was no apparent consolidation in the lungs. The Well-Felix test revealed a titre of 1/25. Abdominal distension commenced; a mottled rash was seen on the abdomen. The blood pressure was 120 millimetres of mercury, systolic, and 40, diastolic. On the eleventh day the patient was cyanosed. The systolic and diastolic blood pressures were respectively 96 and 76 millimetres of mercury. He died on the thirteenth day. At this stage the pulmonary signs were less marked. The blood pressure seven hours before death was 80 millimetres of mercury, systolic, and 60, diastolic.

Venous pressure was estimated in fifteen cases by means of a graduated tube connected to a needle which was inserted into the median basilic vein. In no instance was the pressure raised above normal limits. Although pulsation of the jugular vein was observed, it was not a marked feature.

Well-marked peripheral œdema was recorded in thirteen cases, but small amounts of pitting œdema of the ankles were commonly seen in severe cases. The œdema was usually seen in the ankle region. It was also present over the sacrum and in the scrotum. In one case in which there was no albumin in the urine there was slight œdema of the face.

CASE VI.—Private H. had an eschar, glandular enlargement and fever, with a Well-Felix titre greater than 1/250. He was dangerously ill throughout, and on the eleventh day the congestive changes had developed to typical bronchopneumonia. Circulatory failure occurred at this stage with a pulse rate of 138 per minute and a falling blood pressure of 96 millimetres of mercury, systolic, and 64, diastolic. Severe œdema of the feet, scrotum and sacrum was present. Abdominal distension was severe and intractable. The œdema was relieved on several occasions by injections of "Mersalyl". Death occurred on the fortieth day of the disease. At autopsy there were three infected infarcts in the right lung with pleural effusion. The heart was flabby, pale, but not dilated; the valves were normal. The kidneys were pale toxic and the liver showed much fatty change.

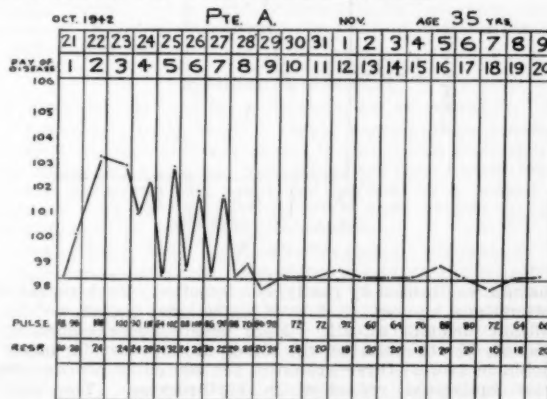


FIGURE VIII.

In general the peripheral circulation in the skin was well maintained, for the colour rapidly returned to normal after digital pressure. Cyanosis, particularly of the lips and extremities, was observed, but may have been due to changes in the lungs. Peripheral failure was certainly present in the final stages before death, and in severe cases in which the patients appeared to have a crisis with drenching sweats.

#### Femoral Thrombosis.

Femoral venous thrombosis was seen in four cases. Two case histories follow.

CASE VII.—Private S. developed thrombosis of the left femoral vein in the second week of scrub typhus. He was at the time seriously ill with fever, moist sounds in the lungs and mental irritability. In addition he had malaria. The Weil-Felix test gave a positive reaction in a dilution of more than 1/250. Fever subsided on the twenty-third day and the patient was well enough for evacuation on the forty-ninth day.

CASE VIII.—Private B. was admitted to hospital after four days' illness and became seriously ill with rash and glandular enlargement, but no eschar. The Weil-Felix reaction was obtained with a titre of 1/250. He developed neurological and mental signs with stupor, restlessness and deafness. On the nineteenth day he developed a right thrombophlebitis which was healed on the thirty-eighth day after incision of two abscesses in the line of the vein.

### The Blood.

#### Erythrocytes.

Mild anaemia with a haemoglobin reading between ten and twelve grammes per 100 cubic centimetres was common. This could be attributed in many instances to previous malarial attacks. Only when there was a progressive anaemia demonstrated by examinations repeated every two or three days could one be sure that this

was 7,770 per cubic millimetre (limits 3,100 and 20,000). It is evident from this that a leucocyte count is of little value in the diagnosis of scrub typhus except in so far as it helps to exclude other diseases which typically show leucopenia or leucocytosis.

The percentages of the different types of leucocytes were determined in the usual way by "differential count", and from these percentages the "absolute" values for each type were calculated. The following remarks refer to these absolute values, that is, to the number of neutrophile polymorphonuclear cells, lymphocytes *et cetera* per cubic millimetre and not to their relative proportions.

The neutrophile cells were increased in the presence of pyogenic complications such as bronchopneumonia. A marked neutrophile leucocytosis was therefore of clinical importance in that it often helped in the decision as to whether sulphonamide drugs should be given. In fatal cases sometimes neutropenia was present. A shift to the left in the Arneth index was usually observed.

The eosinophile polymorphonuclear cells were sometimes very scanty in the early stages of the disease and increased to 800 to 1,000 per cubic millimetre during convalescence, but this was not a constant finding.

### LYMPHOCYTE COUNTS IN TYPICAL PATIENTS

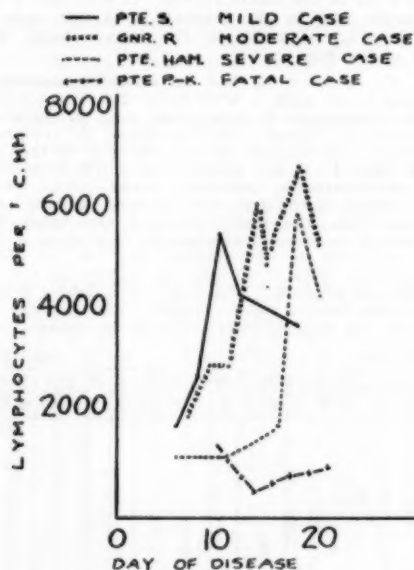


FIGURE IX.

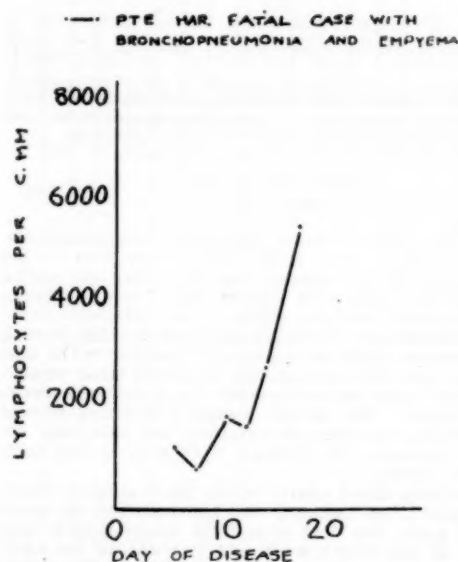


FIGURE X.

anaemia was caused by the typhus infection. Such repeated estimations showed that mild infections caused no significant anaemia at all. More severe cases commonly showed, by the end of the fever, a decrease in haemoglobin of two to three grammes per 100 cubic centimetres with equivalent reduction in erythrocytes. The most marked anaemia observed was in a fatal case, in which the haemoglobin fell to eight grammes per 100 cubic centimetres before death. Beyond the usual changes associated with secondary anaemia, no other morphological abnormalities were noted in the erythrocytes.

#### Leucocytes.

The total leucocyte count varied widely, but the average figure was within normal limits. Individual cases often showed a slight increase in leucocytes during the course of the fever. The mean of forty-one leucocyte estimations on thirty-one patients during the first ten days of their illness was 5,850 per cubic millimetre (limits 3,100 and 12,400); the mean of one hundred and eighteen estimations on fifty-six patients between the tenth and twentieth days

The monocytes showed no significant changes except in those patients who were also infected with malaria.

The lymphocytes appear to play a more important part in typhus than do the other leucocytes and will be discussed in greater detail. In nearly all non-fatal cases there was an increase in lymphocytes just before the patient started to show clinical improvement. The more severe and the more prolonged the illness, the later did this lymphocytosis occur. In fatal cases there was no lymphocytosis except in the occasional case of the patient who died, not from "uncomplicated" typhus, but from a secondary pyogenic infection such as bronchopneumonia or empyema.

Typical examples are shown in Figures IX and X. In these graphs are charted serial lymphocyte counts on different days of the disease. Private S., suffering from mild infection, was never very ill and was afebrile by the eleventh day. His lymphocyte count started to increase early in the second week and reached 5,000 per cubic millimetre by the tenth day and then decreased again. Gunner R. was moderately ill and was pyrexial for eighteen



days. His blood showed a lymphocytosis towards the end of the second week. Private H. was dangerously ill, and at one stage was not expected to survive, but he finally recovered. His lymphocytes remained below 2,000 per cubic millimetre until the sixteenth day and then increased rapidly. Private P.K. died on the twenty-second day of his illness. Instead of the lymphocytosis observed in the non-fatal cases, his blood showed a lymphopenia to the end. At autopsy there was no evidence of pyogenic infection. Death was due simply to the overwhelming rickettsial infection. Private H.A.R. (Figure X), on the other hand, besides a Weil-Felix titre of 1/2,500 and other unequivocal signs of scrub typhus, had, at autopsy, a bronchopneumonia and purulent pleurisy. During his illness he developed a leucocytosis of 20,000 per cubic millimetre. This was mainly a neutrophil leucocytosis, but there was also a lymphocytosis of over 5,000 per cubic millimetre. One is tempted to suggest that this lymphocytosis indicates that the patient might have mastered his rickettsial infection had not the secondary pyogenic infection supervened.

The above patients were chosen as providing typical examples of mild, moderate, severe, fatal and "complicated" cases. From considerations of space lymphocyte graphs of other patients are not shown, but the complete results are shown in tabular form in Table V. The infections were classified on clinical grounds as mild or moderate, severe and fatal. The lymphocyte counts were divided into those made in the first ten days and those made in the second ten days of illness. For each subdivision the mean lymphocyte count and the standard error of the mean were calculated (one realizes that these standard errors, calculated in each instance on a basis of less than twenty cases, are not statistically valid, but they are included in the table to give some idea of the variability of the results).

The relationship between the lymphocyte count and the severity of the illness is evident from this table. In mild and moderate cases there was, on the average, a significantly higher lymphocyte count than in severe cases. In fatal cases there was, on the average, as low a lymphocyte count in the second as in the first ten days, that is, there was no lymphocytosis.

It is not, in a paper of this nature, proper to discuss in detail the immunological implications of these findings. We wish simply to draw attention to the analogy between scrub typhus and a pyogenic infection such as pneumococcal lobar pneumonia. Polymorphonuclear leucocytes help the body to overcome an infection by the pneumococcus; a scarcity of polymorphonuclear cells in the blood in pneumonia indicates that the host is not responding satisfactorily. This is of serious prognostic import. In scrub typhus, the generalized lymphoid hyperplasia, the small round cell infiltration of tissues such as those of the heart and kidneys, and the lymphocytosis in the blood, indicate that the cellular response of the body to rickettsial infection is lymphocytic rather than polymorphonuclear. The actual role of the lymphocyte in this connexion is obscure, but the practical point arising from these observations is clear—a persistently low lymphocyte count in scrub typhus means that the prognosis is poor.

#### Respiratory System.

Abnormal physical signs in the lungs were recorded in 279 cases (44%). Cough was common early in the disease and râles and rhonchi were frequently noted at that stage.

In practically all the moderately serious or severe cases these signs were present from the seventh day onwards, but in the more favourable cases the signs were transient and did not show the steady progression seen in the serious cases. In a severe case some dulness to percussion was present with, on auscultation, diminished vesicular murmur and abundant crepitations, râles and rhonchi to be heard over the area of both lower lobes. Sometimes there were the added signs of a small pleural effusion. The pleural effusions were never large enough to require aspiration.

Coincident with these signs was the development of cyanosis of the lips and extremities and increased respiratory rate to forty in the minute. The respirations further increased on movement or other stimulation. The *ala nasæ* did not take part in the respiratory movements. Mouth breathing was common and sometimes made it difficult to administer oxygen by the nasal mask. Irritating cough with tenacious white or blood-streaked frothy non-purulent sputum was present. The sputum contained pus cells. Culture revealed a mixed bacterial flora without a predominance of any particular pathogenic organism.

In non-fatal cases the abnormal chest signs began to disappear towards the end of the third week, completely disappearing by the fourth week. Radiological examination in the fourth week was conducted in twenty moderately serious and severe cases and no abnormality was found in the lung fields.

In three cases lobar pneumonia developed on the pre-existing lung condition. In those cases where there was patchy consolidation, tubular breathing, crepitations and a persistence of signs beyond the period described above, broncho-pneumonia was diagnosed (67 cases). It was the opinion of the writers that in nineteen cases (8%) the condition of true pyogenic consolidation occurred as distinct from that condition found in the larger proportion of cases.

Pulmonary infarction occurred in six patients. The characteristic onset was with sudden pain in the chest and blood-stained sputum with increase in the respiratory rate and some general distress. Clinical and radiological examination revealed the presence of some consolidation in one lobe, and in one case there were repeated infarctions. None in fact was sufficiently large or serious enough to cause sudden death. Pleural effusion, in two cases blood-stained, followed infarction. In none of these cases did empyema ensue.

#### Post-Mortem Findings.

Post-mortem findings in 58 cases are as follows:

The trachea and bronchi always contained blood-stained frothy mucus. The mediastinal lymph glands were always enlarged and congested. Subpleural petechial hæmorrhages were marked in 30% and less prominent in a number of others. These hæmorrhages were most evident on the diaphragmatic and interlobar surfaces.

The lungs were markedly congested, particularly in their dependent parts. Sometimes actual patchy consolidation was present, but for the most part the lungs, though they appeared firm, would float in water and bloody froth could be squeezed from them. In no instance were these changes more marked in the upper than in the lower lobes. Two patients who both died in the sixth week had multiple pulmonary abscesses. The distribution and appearance of

TABLE V.  
To show Relationship between Lymphocyte Count and Severity in First and Second Ten Days of Illness.

Clinical Type.	First Ten Days.			Eleventh to Twentieth Day.		
	Mean Lymphocyte Count per Cubic Millimetre.	Standard Error of Mean.	Number of Cases Investigated.	Mean Lymphocyte Count per Cubic Millimetre.	Standard Error of Mean.	Number of Cases Investigated.
Mild and moderate .. ..	2,250	193	13	3,510	353	17
Severe .. ..	1,330	128	11	2,700	363	12
Fatal .. ..	1,290	197	7	1,190	229	12

these abscesses suggested that they were infected infarcts. One patient had bronchopneumonia with fibrinous pleurisy.

Ten lungs were examined microscopically. In some, the most conspicuous feature was the extreme congestion. Both alveolar walls and alveolar spaces were filled with a mixture of polymorphonuclear cells, lymphocytes, plasma cells and large mononuclear cells. The same mixture of cells was seen in the bronchioles. Intraalveolar fibrin was only very occasionally seen. All specimens contained macrophages full of brownish pigment. They resembled "heart failure" cells and were sometimes very numerous. It is impossible to dogmatize on either the clinical or pathological changes occurring in the lungs in scrub typhus. It is the opinion of the writers that if scrub typhus is presumed to be a disease chiefly affecting the vascular endothelium, the changes in the lungs are due to such a mechanism operating in the wide endothelial beds provided in the lungs. This pulmonary damage results in a transudation of fluid and extravasation of erythrocytes and other blood cells into the alveoli.

Circulatory failure contributes to this picture of extensive pulmonary congestion. Finally, posture may determine the basal distribution of changes, as in the so-called "hypostatic pneumonia".

#### The Liver.

Although some tenderness under the right costal margin was not uncommon, the liver was seldom palpably enlarged. Jaundice, in the absence of coincident malarial infection, was rare.

At post-mortem examination the liver was usually somewhat enlarged (average weight 72 ounces). The external appearance was normal. There was no sign of perihepatitis. Subperitoneal haemorrhages (described by Lewthwaite in Malayan scrub typhus) were not observed. The appearance of the cut surface varied with the degree of congestion. Some livers showed irregular mottling with light and dark areas and resembled the "nutmeg" liver of chronic venous congestion. Others were more uniformly pale and "toxic" or even frankly yellow and fatty.

Twelve livers were examined microscopically. All showed cloudy swelling and fatty degeneration. The fatty change appeared to be related to the length of the illness, being only slight in two patients who died on the ninth and eleventh days respectively and very marked in one who died on the twenty-eighth day. The fat was usually perlobular in distribution; in only one instance was it more marked centrally round the hepatic veins. Pigment-containing macrophages and Kupffer cells were sometimes seen, probably indicating a previous or coincident malarial infection. In some there appeared to be an increase in the small round cells in the periportal tissue, but this was not marked. No changes were seen in the blood vessels or bile ducts.

#### The Spleen.

Enlargement of the spleen was seldom detected clinically, except in patients who had malaria. Palpation to determine splenic enlargement was made difficult by abdominal distension in the case of patients who were ill. Post-mortem examination showed that the spleen was nearly always enlarged and softened. This softened state was the probable reason for inability to feel the spleen when that examination was attempted.

The results of post-mortem examinations are as follows. All except two of the spleens were enlarged (average weight sixteen ounces). The spleens from patients who died in the fourth and sixth weeks respectively were normal in size. Five spleens contained medium-sized "white" infarcts (three had two infarcts—two had one). Perisplenitis in the form of scanty thin fibrinous exudate on the splenic peritoneum was seen occasionally. More frequently there was no frank exudate, but the splenic peritoneum had lost its normal sheen and was roughened to appearance and feel. The pulp had lost its normal architecture and was dark red in colour and soft—sometimes soft enough to be washed away under a stream of tap water. Seven spleens were examined microscopically. They were all very engorged with blood. In many places the trabeculae and sinuses had disappeared

and were replaced by red cells, small round cells, macrophages and a few polymorphonuclear cells. Occasionally the Malpighian arterioles were thickened, the thickening being due to swelling of the endothelial cells; but this was not marked or common. Localized nodular thickenings of the vascular endothelium due to infiltration with inflammatory cells were not seen.

#### The Gastro-Intestinal Tract.

Anorexia was present in the early stages and persisted while the fever lasted. Fluids and light attractive food such as egg flips, jelly and malzena were well tolerated.

Dysphagia troubled some of the sicker patients, but seldom presented a difficult problem in the maintenance of a good fluid balance.

Vomiting sufficient to prevent a total oral fluid intake of 120 ounces daily was very rare. Abdominal pain and indigestion were not a feature. Diarrhoea was present in 68 cases, mostly severe ones, and it was difficult to decide whether it was due to the disease *per se* or caused by a superadded bowel infection. With diarrhoea brown food stools were usual, and in seven cases blood and mucus were present. In five of these a dysenteric organism was isolated on culture. At that time dysentery was occurring amongst the troops from the same area.

Although in many severe cases diarrhoea did not occur, it is thought that diarrhoea in some cases of scrub typhus is a symptom of that disease, and is not necessarily due to coincident dysenteric infection.

Abdominal distension was nearly always due to dilatation of the transverse colon, and was observed in twelve severe cases, confirmed at post-mortem examination. It was sometimes difficult to ascertain whether dilatation of the stomach was present, but in no case at post-mortem examination was this found in any severe degree. The distension was temporarily relieved by insertion of a rectal tube.

#### The Kidneys.

**Water Balance.**—It was usually possible to induce the patient to take between 100 and 140 ounces of fluid per day. Urinary output was, on the average, forty to sixty ounces. Anuria was not observed.

**Urine.**—A trace of albumin was found in nearly all cases at the acute phase of illness. It was usually transient, not marked and not found in convalescence. The quantity of albumin was increased in severe and fatal cases. Red cells were seldom seen and were never in great quantity. Hyalogram casts were usually found at the height of the illness in severe and fatal cases, but were not observed otherwise. Urobilin was constantly found during the fever.

**Blood Urea.**—Seventy-four blood urea estimations were carried out on 32 patients. These patients were selected at random, but included some severely ill patients with a large amount of albumin and casts in their urine. In six instances the blood urea content was between 60 and 70 milligrammes *per centum* and only once was it over 70 milligrammes (73 milligrammes *per centum*). Serial tests showed that there was a small but consistent rise in the blood urea content between the twelfth and eighteenth days, but it quickly fell to normal by the beginning of the fourth week.

#### Post-Mortem Findings.

The kidneys were usually somewhat enlarged (average weight seven ounces). One kidney had a small white infarct. The cortex and medulla showed no constant changes, being sometimes engorged, sometimes pale and toxic. Minute petechial haemorrhages were commonly observed in the epithelium of the kidney pelvis.

Thirteen kidneys were examined microscopically. Small collections of lymphocytes and plasma cells were seen in both cortex and medulla. Sometimes flame-shaped haemorrhages, surrounded by a zone of small round cells, were present in the cortex. Parenchymatous changes were slight and restricted to cloudy swelling of the convoluted tubules. The glomeruli were normal in appearance. No changes were seen in the blood vessels.

### The Central Nervous System.

Mental or neurological abnormalities were noted in 231 patients out of a total of 626, an incidence of 37%. These 231 patients fell into diagnostic groups as follows:

1. Agglutination to Proteus OXK in titre of 1/250—145 cases.
2. Agglutination to Proteus OXK in titre of 1/125—48 cases.
3. Agglutination to Proteus OXK in titre of 1/50—11 cases (and supported by clinical findings).
4. No agglutination to Proteus OXK, but cases in which a clinical diagnosis was made with confidence—29 cases.

### Mental Changes.

The following symptoms and signs were noted and accepted as mental changes occurring in scrub typhus: euphoria, irritability, delirium, drowsiness, stupor, confusion, apathy and depression, delusions, hallucinations, late neurotic phenomena. It is not suggested that they are in any way typical of this disease alone.

**General Description.**—It was an almost general rule that mental symptoms occur in those patients seriously ill with scrub typhus. During the first four days of the illness the mental state was normal; any change being towards a mild degree of euphoria or towards apathy.

From the sixth to tenth day of illness, patients who were ill showed more pronounced changes. These patients fell into two groups—the over-active and the depressed, according to whether the psychomotor activity was increased or diminished. The latter group of symptoms occurred most commonly. Mixed forms occurred in the one patient or each form alternated with the progress of the disease.

**Over-Active Group.**—The euphoria already present in the first four days deepened and the patient failed to recognize the seriousness of his illness, perhaps passing to convalescence without experiencing any of the concern about his condition which his medical officer felt. In a few the euphoria coloured the state of toxic confusion and delirium which supervened in some between the tenth and fourteenth days. Many were difficult to keep still, and made demands to sit out of bed.

One patient, both confused and euphoric, demanded that a large sum of money be withdrawn from his paybook. Another presented the features of a Korsakov's psychosis, and described in minute detail a fantastically successful and lone-handed attack in which he had destroyed 38 "Zeros" flying above the ward. Another described to the last detail a meal of steak and eggs he had just eaten, whilst another had the equally delusional belief that he was married to his nurse. One patient developed a well-organized delusional scheme which persisted for five days. Visual and auditory hallucinations were present in two cases.

Restless irritability was a striking feature in other patients in the over-active group. Although the subjects of special nursing attention and receiving special delicacies of diet, they remained querulous, demanding and petulant, never comfortable and never pleased. When this state was mingled with confusion, they would suddenly get out of bed in an effort to reach the latrine. Some with depression as an added feature complained that little was being done for them.

Insomnia was common and in few cases almost intractable except to heavy sedation with morphine or hyoscine. Delirium, of either the quiet or noisy type, was observed at the latter end of the second week in a number of severe and fatal cases.

**Depressed Types.**—More than half the patients who showed a disordered mental state became atonic and apathetic, lying motionless and inert, drowsing through the tenth to the seventeenth day of severe illness—mildly confused and not readily "accessible". Feeding and maintenance of fluid intake in these patients required skilful and persistent nursing attention.

A few became both depressed and retarded. Forty-four became stuporose in the second week of the disease. When coma developed, recovery was rare.

It has been suggested that a uræmic factor was present, either causing or increasing the state of drowsiness. As has been noted, this suggestion was not borne out by blood urea estimations.

In all patients who recovered, the mental state very quickly returned to normal with clinical recovery in the third week. Several patients reported with neurotic symptoms in very late convalescence. It is not certain that scrub typhus played anything more than a contributory part in the formation of these neuroses. One case is recorded below (Case VIII) of what appears to be a true neurasthenic state occurring after scrub typhus, and possibly due to a shortened convalescence.

**CASE VIII.**—Major T., aged thirty-six years, had a rash, eschar, glandular enlargement, fever for fifteen days and a Weil-Felix reaction with a titre of 1/250. The course of the illness was not severe and there were no respiratory or cardiac complications. He was discharged after 51 days of hospital treatment, a shortened convalescence being influenced by military considerations. Within three weeks of return to duty he developed headaches, lassitude and lost concentration. He was unable to continue his duties. His personality and record prior to illness showed no evidence of constitutional tendency towards neurotic reactions.

### Neurological Features.

The following symptoms and signs were regarded as significant neurological features.

Symptoms.	Signs.
Headache	Deafness
Giddiness	Change in deep reflexes
Tinnitus	Change in superficial reflexes
Photophobia	Paralyses and paresis
Dysphagia	Tremor
Paræsthesiæ	Incontinence
Neuritic pain	Retention
	Hyperæsthesia
	Dysarthria

**Headache.**—Headache was regarded as significant for purposes of this survey only when it was severe, constant or intractable or appeared to be closely related to other coincidental neurological phenomena such as stiff neck, high cerebro-spinal fluid pressure and other signs mentioned. In such a form it occurred in 53 cases. It seldom occurred in such severity before the sixth day, and in a few cases did not disappear before the end of the second week.

In those with an associated high cerebro-spinal fluid pressure, lumbar puncture gave almost immediate relief when the pressure was reduced to 120 millimetres of cerebro-spinal fluid.

**Giddiness.**—Giddiness was reported in four cases, in the first week of disease. It was present when the patient sat up or moved about, but was never severe enough to produce vomiting.

**Tinnitus.**—Tinnitus occurred as a marked feature in two cases. It persisted for about fourteen days. In other patients complaining of tinnitus it seemed likely to be due to associated cinchonism.

**Photophobia.**—Although photophobia was a common onset symptom, it was persistent in the first ten days in four cases only.

**Dysphagia.**—Dysphagia occurred in three cases on or about the twelfth day. It was transient and not severe.

**Deafness.**—Nerve deafness was by far the most prominent neurological finding, being present in 90 cases. It was unilateral in four. Deafness occurred as early as the fourth day of illness and persisted as long as to the sixtieth day. However, it was commonly detected about the fifth day and lasted two to six days. It varied from slight deafness to a severe grade. It was only once complete or permanent. Normal hearing was regained early in convalescence. Many of these patients had not taken quinine.

**Deep Tendon Reflexes.**—A change in deep tendon reflexes, particularly in the lower limbs, was found to occur towards the end of the first week, and was quite independent of stupor or coma. Early in the disease deep reflexes were sometimes increased. Reduction or absence of deep tendon reflexes was noted in 102 cases. The knee



jerks were markedly depressed or absent in 47 cases, the ankle jerks in 50. Biceps and triceps jerks were much less commonly affected (five cases). The deep reflexes usually returned to normal within two days to a week in those patients who recovered. In fatal cases, loss of all deep reflexes occurred as part of the late stupor or coma.

**Superficial Reflexes.**—Superficial abdominal and cremasteric reflexes were lost with the deep reflexes. They were most frequently absent when the cerebro-spinal fluid pressure was raised. A Babinski response was noted in three instances. These changes disappeared within seven days.

**Paresis and Paralysis.**—Two patients developed paresis of the shoulder girdle muscles. A précis of their clinical course follows.

**CASE IX** (scapulo-humeral paresis).—Lance-Corporal I. developed a paresis of the biceps, triceps and deltoid muscles on the left side, 44 days after the onset of fever. He had a rash and eschar with marked glandular enlargement during his illness with Weil-Felix agglutination in a titre of 1/125. Some improvement was noted prior to his evacuation three weeks later.

**CASE X** (scapulo-humeral paresis).—Gunner W. suffered from a mild infection of scrub typhus with marked generalized glandular enlargement, twenty days of fever and an agglutination reaction.

On the twentieth day of his illness he developed moderate weakness in abduction and external rotation of the shoulder and weakness in flexion at the elbow on the right side. The weakness was ushered in by pain in the region of the shoulder lasting for a few days. There was little evidence of the paresis ten days later.

Ptosis of the right eyelid appeared in one case on the sixteenth day of illness and was improving three weeks later. One patient developed paresis of the right diaphragm and left *serratus magnus* muscle.

**CASE XI** (paresis of the right side of the diaphragm and left *serratus magnus* muscle).—Private S. was admitted to an advanced dressing station with one day's history of headache and backache. The blood film was positive for benign tertian malaria. He ran a continuous pyrexia for eighteen days and was admitted to hospital on the twentieth day, cyanosed, with inguinal adenitis and slight deafness. The knee jerks were absent. The clinical diagnosis was scrub typhus. Following some pain in the right side of the chest on the thirtieth day, X-ray screening showed paralysis of the left side of the diaphragm with paradoxical movement. The lung fields were clear. Subsequent response to the Weil-Felix test was negative (titre of 1/50). On the thirty-seventh day of illness a marked paresis of the left *serratus magnus* muscle appeared.

There was no improvement in either paralysis in the following three weeks before the patient's evacuation to the mainland.

One patient showed a transitory enlargement of the right pupil in the second week of disease. In one patient the palate was found to deviate to the right side on phonation on the twenty-eighth day of illness; the abnormality was not present ten days later.

General muscular weakness with marked wasting was seen in all the most severe cases and persisted for three to four weeks after the subsidence of fever despite dietetic measures.

**Sensory Changes.**—Five patients developed sensory loss during convalescence. In two or three the loss corresponded to the sensory distribution of the ulnar nerve. In the remainder the changes were noted in the lower extremities.

**CASE XII.**—Gunner R. had an eschar, rash, generalized adenitis and a Weil-Felix reaction with a titre of 1/250. There were rhonchi to be heard at the bases of both lungs. On the tenth day it was noted that he had loss of pain sensation in the approximate distribution of the right superficial peroneal nerve. The length of time during which anaesthesia persisted was not recorded.

**CASE XIII.**—Sergeant T. had severe scrub typhus with rash, eschar, glandular enlargement and mental changes. In the first ten days of illness he had a cerebro-spinal fluid pressure of 280 millimetres. Babinski responses were present. On the forty-fifth day, during convalescence, he developed anaesthesia to all forms of sensation over the ulnar border of the hand, wrist and one and a half ulnar digits. There was some weakness in adduction of the fifth to the fourth finger. There was no improvement after thirty days of intensive vitamin B<sub>1</sub> therapy.

**CASE XIV.**—Corporal P. had been dangerously ill for twenty days with a history of eschar, glandular enlargement and eighteen days of fever. He was emaciated and anæsthetic. On the sixty-first day he developed analgesia and anaesthesia over the buttock in the "saddle area" corresponding to the distribution of the second and third sacral nerves. There was no change one week later. The usual vitamin B<sub>1</sub> therapy had been intensified during that period.

**CASE XV.**—Private W. had onset symptoms of headache, malaise and numbness in the arms and legs. He had an eschar, rash and strong agglutination reaction. On the twenty-fifth day after onset, he developed hypoaesthesia to pin prick and deep pressure over a large area on the lateral surface of each thigh. Sensation to cotton wool was not disturbed. He responded only partially to vitamin B<sub>1</sub> therapy and the condition was still present on the forty-fourth day of illness.

**Tremor.**—Transient slow tremor of the hands occurred frequently during the second week. In eight patients, this attracted more than usual attention. It occurred mainly in the distal joints of the upper limbs and sometimes at the ankle joints. It was spontaneous and remained active for a few moments and then subsided. The rate approximated to that seen in Parkinsonism. Isolated tremor of the "pill-rolling" type was noted on one occasion in the right hand. Pronation-supination tremor was noted but rarely. Flexion-extension tremor at the ankle joints was noted in two patients.

**Paræsthesia.**—Paræsthesia was present in the toes of four patients.

**Hyperæsthesia.**—Hyperæsthesia of the extremities was present in six patients.

**Incontinence and Retention of Urine.**—Retention of urine was recorded in the case of ten patients, all of whom were seriously ill; the retention occurred at the end of the first week to the end of the third week of the disease. Incontinence was recorded in the history of five patients, all of whom were in a "typhoidal" state.

**Vascular Accidents.**—The following cases are reported as vascular accidents, presumably a complication of scrub typhus.

**CASE XVI.**—Lieutenant R., admitted to hospital on April 1, 1943, with scrub typhus, was seriously ill in the first fourteen days of illness. Agglutination to Proteus OXK was present in a titre greater than 1/250 on the sixteenth day. The main features of the first fourteen days of illness were the presence of eschar, glands, moist sounds in the chest and a blood pressure falling to 94 millimetres of mercury, systolic, and 62 millimetres, diastolic. On the twelfth day he was reported as mentally a little "strange". Fever lasted for eighteen days. On the twenty-eighth day of illness he was well and had been afebrile for four days. On the twenty-ninth day he had an epileptiform fit with tonic and clonic phases, cyanosis and vomiting. Following the fit there were no abnormal signs beyond exaggerated tendon reflexes. The cerebro-spinal fluid was under increased pressure, and contained one lymphocyte and twenty-eight red blood corpuscles per cubic millimetre. Its protein content was 60 milligrammes per 100 cubic centimetres and the chloride content (as sodium chloride) was 690 milligrammes per 100 cubic centimetres.

During the next few days, the patient was dysphasic and exhibited constant sucking movements of the lips and tongue. A frank grasp reflex was present on the right side. No other abnormal neurological signs were present. The mental condition deteriorated in the next three days and the patient showed poor attention. There was incontinence of urine and faeces. He became facile and irresponsible. Speech was limited to a few words and was sometimes spontaneously repetitive. The grasp reflex of the right hand persisted for some days, together with slow tremor of the hand and arm on that side.

There was marked "tremor" of the tongue and generalized wasting was present. The cerebro-spinal fluid on the thirty-second day was turbid, had a pressure of 170 millimetres and contained 138 lymphocytes, 30 polymorphonuclear cells and 130 milligrammes of protein per 100 cubic centimetres. The chloride content was 710 milligrammes per 100 cubic centimetres. No organisms were seen.

On the fiftieth day of illness the patient was improving physically, but showed marked mental reduction with transient disorientation and memory lapses. The memory for recent events was extremely defective. On the

seventieth day there was mild general reduction in memory. Behaviour was normal. The patient had regained more of his usual poise.

**CASE XVII.**—Private C. was admitted to hospital with a history of five days' fever. Malignant tertian gametocytes had been found in the blood and he was on "Atebrin" treatment. The temperature was still raised. Three days after admission, he had a "queer" turn and was found shortly afterwards to have a left-sided hemiparesis including the face. There was in addition diminution of the discriminative elements of sensation over the left hand. Within four hours he had very slight paresis with a Babinski response on the left side.

The facial paresis persisted and there was an increase in deep reflexes on the left side, and absence of the superficial abdominal reflexes on the left side for ten days.

Twenty days after the onset of hemiparesis there was a slight facial weakness. His Weil-Felix titre was 1/250.

#### Cerebro-Spinal Fluid Survey.

The cerebro-spinal fluid was examined in the case of sixty patients with scrub typhus at stages in the illness ranging from the fifth to the fifty-third day. In nineteen of these no evidence of neurological abnormality was detected clinically.

**Cerebro-Spinal Fluid Pressure.**—The cerebro-spinal fluid pressure was raised over 160 millimetres in 26 cases. In these cases eighteen patients had positive neurological signs. In all cases in which patients had a raised pressure sufficient cerebro-spinal fluid was withdrawn to establish a final pressure of 120 millimetres. This often relieved headache and neck stiffness.

**Cellular Elements.**—Cellular elements were increased in eight cases. Lymphocytes more than ten per cubic millimetre were found in seven and red blood corpuscles more than seven per cubic millimetre were found in seven instances.

**Protein.**—The protein content was found to be over fifty milligrammes per 100 cubic centimetres in six cases.

**Chlorides (Sodium Chloride).**—Fifty-two specimens of fluid were examined. The commonest deviation from normal was found in respect of chlorides which were decreased below a level of 700 milligrammes per 100 cubic centimetres in 31 cases. In eight cases in which lumbar puncture was repeated, the cerebro-spinal fluid was normal in all respects. In three of these a third lumbar puncture gave similar findings. Twelve control specimens of cerebro-spinal fluid from patients with post-traumatic neurosis, malaria and enteric fever were normal.

**General Discussion of Findings.**—The cerebro-spinal fluid became abnormal as early as the sixth day of illness, but changes in pressure and in chloride and protein content were commonest about the tenth day and persisted as long as to the nineteenth day. No abnormalities were seen after the twentieth day of illness, although abnormal signs such as peripheral neuritis were present at this time. There was no relationship between spinal fluid findings and the presence or absence of neurological signs. However, abnormalities in pressure and in chloride values were approximately twice as frequent in severe cases with neurological signs as in cases without such signs.

#### Post-Mortem Material.

The brains of seventeen patients were examined *post mortem*. In nine instances the examination was made within two hours of death.

Macroscopically, the surface of the brain was oedematous, the cerebro-spinal fluid was increased in amount and the superficial cortical veins were congested. The dural membranes were normal. The cut surface of the brain showed general congestion. No hemorrhages or thromboses were seen. The ventricles appeared normal in size.

Paraffin sections stained with hematoxylin and eosin were made from cerebral cortex and hippocampus, basal ganglia, mid-brain, red nucleus, pons, cerebellum, medulla and spinal cord. The changes to be described were not consistently more marked in one area of the brain or cord than in another. These changes observed were perivascular infiltration of cells, and some abnormality of the walls of at least one small vessel.

The perivascular infiltration consisted in small collections of small round cells—plasma cells and macrophages. It is emphasized that these collections were not common, and were hard to locate. The total number of cells in any one collection did not exceed twenty. In no case did the collections approximate to the marked perivascular "cuffing" described in poliomyelitis or epidemic encephalitis. There was no relationship between the number of collections and the presence of abnormal neurological signs *ante mortem*.

**The Vessels.**—In most sections it was impossible to state definitely that the walls of the small vessels of the grey and white matter were abnormal in structure because of the distortion of such vessels which occurs in ordinary paraffin preparations.

One small vessel showed definite infiltration of part of its wall with plasma cells and small round cells. There was a doubtful increase in endothelial cells in the wall of the vessel.

Surrounding the vessel in a mass of pink-staining structureless material were small round cells, plasma cells and macrophages. Apart from the perivascular and vascular features mentioned, no focal collection or general cellular increase in cells could be detected in the brain tissue.

No neuron changes could be detected.

#### Eye Changes.

Pain behind the eyes was complained of in many cases during the stages of fever. Sub-conjunctival congestion was commonly observed at the onset, and often persisted for ten to fourteen days. It did not appear to cause the patient any discomfort. Subconjunctival hemorrhage was observed during the course of the disease and was frequently bilateral. Changes in the optic disk and retina due to thrombosis of the retinal vessels were observed in three cases. In one case the changes were unilateral, in the other two the lesions were bilateral.

**CASE XVIII.**—Private R. had an eschar in the right axilla, enlargement of the axillary glands and signs of severe pulmonary congestion. He was deaf and had retention of urine. In the second week he developed sudden blindness in the left eye from a thrombosis of the central artery of the retina. He died on the thirty-first day. Post-mortem findings were consistent with the diagnosis of scrub typhus.

**CASE XIX.**—Private W. had glandular enlargement, nineteen days of fever and a Weil-Felix reaction with a titre greater than 1/250. He developed pneumonia and complete deafness. In the second week he became suddenly blind in both eyes and was found to have a thrombosis of both central retinal vessels. He was evacuated after forty-two days, by which time both hearing and sight had improved a little. Subsequent reports from non-medical sources state that he was still deaf and blind and was being taught braille.

#### TYPHUS COMPLICATED BY MALARIA.

As many of these patients came from hyperendemic malarious areas, it was to be expected that some would be infected with malaria parasites. Throughout the course of fever thick blood films were examined on alternate days. After the fall of temperature thick blood films were examined if the patient showed a rise in temperature. Eighty-two patients with scrub typhus had an attack of malaria whilst in hospital, and it was noticeable that most of these occurred during convalescence.

#### DIFFERENTIAL DIAGNOSIS.

In the case of a soldier with fever, who has been in a malarious and typhus belt of country, the first disease to be excluded is malaria. If the temperature does not fall within three days of adequate quinine therapy or if no quinine is given and repeated thick blood films are "negative", scrub typhus must be suspected. The presence of an eschar and of enlarged lymphatic glands in the axillae and groins will establish a clinical diagnosis; later a rash may become evident. The clinical diagnosis will usually be confirmed by the Weil-Felix test after the eleventh day. In the absence of an eschar, and when

cases of dengue are occurring, difficulty is sometimes met in distinguishing that disease from scrub typhus during the first five days of fever. The fever of dengue seen during this period very seldom lasted more than five days.

The most helpful sign in differentiating scrub typhus from the typhoid group of diseases is the enlargement of the lymph glands in scrub typhus.

#### PROGNOSIS.

The prognosis depended on the interaction of a number of factors. The state of physical health of the patient prior to infection certainly influenced the severity of the illness. Physical exhaustion, debility from inanition, infection with malaria and dysentery prior to the onset prejudiced recovery. During one phase of the Gona-Sanananda attack where these factors strongly existed, the mortality rate for 150 consecutive cases was 25%.

If the patient was over thirty-five years of age the outlook was serious. Of 101 patients over thirty, 14 died (mortality 14%), and of 323 patients under thirty, 22 died (mortality 7%). The promptness with which the patient was able to cease duty and go to bed influenced the severity of the disease. Case II illustrates this point.

Patients who develop states of excitement, confusion or delirium do badly unless sedation is effective in rendering them restful. Unfavourable signs included (a) severe prostration developing before the sixth day; (b) hyperacute infections in which the patient presented the usual features of the fourteenth day on the seventh day; (c) severe deterioration in the mental state, such as intractable delirium or coma; (d) the onset of marked neurological phenomena such as tremor or twitchings; (e) signs of threatened circulatory failure with weak heart sounds, presence of cardiac irregularities, pulse rate of over 140 or systolic blood pressure falling below 80 millimetres of mercury; (f) the presence of large numbers of casts in the urine persisting for more than three days; (g) lobar pneumonia or bronchopneumonic consolidation.

As most patients with severe complications were evacuated to the mainland, we were unable to observe the final results, so that we cannot express an opinion on the average time elapsing before patients become fit for duty. There are reasonable indications that the prognosis of peripheral neuritis does not differ from that of other forms of neuritis. Evidence is increasing that no permanent cardiac disability results from scrub typhus. Many patients in this series, though seriously ill in the acute phase, have been returned to duty after adequate convalescence in New Guinea. None has been readmitted to hospital with cardiac or other serious disability.

The mortality varied during the period of the investigation. In the first 100 cases there was one death, in the second 100 there were two deaths, while in the next 150 there were 37 deaths (25%). In the last-mentioned group the soldiers were debilitated by a strenuous military campaign and by the effects of diarrhoea and malaria. The mortality varied little in the next 276 cases, in which there were 21 deaths (7.2%). Of the total 626 patients, 61 died, mortality being 9.7%. The mortality among all cases reported in New Guinea is between 6% and 7%. The higher mortality (9.7%) in our series is due to the inclusion of the group of patients suffering from exhaustion who showed a high mortality rate.

It is impossible to state whether the virulence of the organism varied from one area to another, or in the same area from time to time, as so many other factors required consideration.

In fifty-eight of the sixty-one fatal cases post-mortem examinations were made. The rapid post-mortem autolysis which takes place under tropical conditions obscures the pathological picture if autopsy is delayed more than a few hours. To avoid this difficulty more than half of the autopsies were performed within three hours of death. A few were done less than half an hour after death.

#### TREATMENT.

The following principles of treatment have been finally adopted after observation of the effects of various suggested measures to influence the course of the disease.

In general, it became increasingly obvious that the useful therapeutic agents to hand were few, but that thorough use of these agents was well worth while.

There is no specific treatment. Serum from convalescent patients was not used in any case. Careful study by other workers has failed to substantiate the claim that convalescent serum is of value in other forms of typhus.

Early medical evacuation and confinement to bed of suspect patients in the first five to six days are of importance. The patient must be evacuated as a "sick lying case" where possible to a general hospital with expert nursing facilities. Patients who are seriously ill tolerate ground transport badly, and are best evacuated by air. If the patient is already seriously ill by the sixth day, or, if the days of fever are more than six already, it is often wiser to treat him on the spot in a main dressing station or field ambulance, rather than risk further movement during the phase of circulatory upset and continuous fever. Expert nursing is the single measure of supreme importance. Seriously ill patients require the attention of one nurse practically all the time. The patient should be nursed in the Fowler's position unless he cannot rest in this position.

Absolute rest during fever is essential. If the patient is restless, adequate repeated sedatives should be freely used. Attention to this should be so stressed that such a statement as "patient restless and got out of bed" should not occur in a night report. Bed rest is necessary till the patient has been afebrile at least ten days. On alternate days during the period of fever a thick blood film is taken for examination for malaria parasites. If this cannot be done suppressive "Atebrin" or quinine is given. Feeding is given by frequent small amounts of fluid and nourishment rich in carbohydrate. A fluid intake of 140 ounces daily should be aimed at and more if possible. Any nourishing solids that can be taken should be used. Eggs when available may be used as "egg flips". Milk drinks provide a good source of protein and calcium. The administration of fluids to querulous or apathetic patients calls for considerable patience on the part of the nurse.

Purgatives are not used, as they may initiate an irritant diarrhoea. Diarrhoea was common when the patient was very ill and often complicated the nursing problem. The stools were examined macroscopically and bacteriologically. In 15% of stools examined bacteriologically a dysenteric organism was found. Sulphaguanidine usually stops the diarrhoea and a full course is given in cases suspected of being dysenteric in origin.

Troublesome abdominal distension is treated by the passage of a rectal tube. One patient collapsed after an injection of 0.5 cubic centimetre of pituitrin given to relieve the abdominal distension. The use of pituitrin is not recommended. Retention of urine necessitated catheterization.

Sodium chloride, 15 to 30 grains, was given daily in an effort to restore loss of chlorides through sweating.

Headaches or general muscular pains are treated with analgesics, aspirin, phenacetin, with a sixth to a quarter of a grain of codein being effective in a number of instances. Should this prove inadequate, the administration of one-sixth of a grain of morphine by injection is advisable. Lumbar puncture has been found efficacious in relieving headache when it is intractable and associated with neurological signs.

It was very seldom necessary to give intravenous transfusion or infusion. On a few occasions small transfusions of whole blood were given to convalescents for anaemia.

Intravenous injections of saline solution or glucose were scarcely ever necessary, as most patients were able to take sufficient fluids if small quantities were given very frequently.

Sedation was of the utmost importance. In the daytime sufficient analgesics, phenobarbital or morphine should be given to ensure rest or sleep. At night time one and a half to three grains of "Nembutal" were the best sedative. If it was ineffective within half to one hour it was followed by morphine injection. Excited restless patients sometimes needed morphine and hyoscine or rarely paraldehyde.

Cough when troublesome is treated with sedative linctus. Atropine was not beneficial for the chest condition. In



ILLUSTRATIONS TO THE ARTICLE BY  
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FIGURE XI.



some instances administration of oxygen improved the patient's colour if he was cyanosed. Oxygen helped to relieve respiratory distress. Sulphadiazine did not appear to be of benefit in the uncomplicated case. It is indicated if pyogenic pulmonary complications are suspected, particularly if the sputum is purulent. The dosage given was three grammes twice a day.

Circulatory "stimulants" were tried and found of very little value. The use of "Coramine" and "Anacardone" did not appear to influence the outcome in any case; and vaso-constrictors of the "Neosynephrin" type were not employed. It appeared that small improvement could be expected from the use of a drug that does no more than remove one sign of an underlying circulatory failure. Digitalis preparations were tried and appeared not to influence the condition of the patient. Vitamins B and C were administered as a routine.

The period of convalescence necessary after scrub typhus depends on the severity of the infection. In mild cases patients might be allowed up at the end of the third week and sent to convalescent depot three weeks later. In more severe cases patients were allowed to walk about the ward in the fifth week of illness, the amount of exercise being controlled by the general condition and the patient's own feelings after such exertion. In the sixth and seventh week he did light ward duties and exercise in the physiotherapy department. In a few cases in which loss of weight was considerable insulin was given in doses of twenty to sixty units daily. The state of mild hypoglycaemia which resulted was terminated after three hours by adequate sucrose drinks. This measure was successful in increasing appetite and weight. Usually, however, the convalescent patient had a good appetite.

Throughout late convalescence it is essential that the patient be reeducated from the mental outlook of acute helpless invalidism which is imposed upon him by three weeks of severe debilitating fever. Most particularly is it necessary to avoid in any way inducing ideas of cardiac disability by repeated examinations of the precordium. As stated elsewhere, there is no evidence that any permanent cardiac disability results from scrub typhus, and the dyspnoea on exertion and other similar complaints are regarded as the normal phenomena of convalescence from any severe illness. To mistake the significance of these symptoms and signs and to fix them in a state of anxiety in the convalescence is to do the patient a great disservice.

Most patients are well enough to be transferred to the convalescent depot in six to ten weeks after the onset of illness, where they stay for a further six weeks. They are then fit to return to their former duties. When malaria complicated scrub typhus, quinine and "Atebrin" therapy was employed in the standard dosage. "Plasmoquine"-quinine treatment was delayed until the period of early convalescence.

#### SUMMARY.

The clinical and pathological findings in 626 cases of scrub typhus are reported. The mortality was 9.7%.

The typical signs were the presence of a primary sore or eschar, generalized lymph gland enlargement and a maculo-papular rash. In severe cases the heart and lungs were involved and the blood pressure was low. Fever lasted fourteen to seventeen days. In atypical and mild cases these signs were not always present, and diagnosis was difficult. A positive response to the Weil-Felix test in these cases was often the deciding factor.

Descriptions of pathological appearances are based on the findings in fifty-eight post-mortem examinations. The Weil-Felix test in which Proteus OXK was used gave a positive result in 86% of cases. A serum titre of 1/125 or greater was regarded as "diagnostic". A slide agglutination test was shown to be reliable with certain limitations. Lymphocytes increased *pari passu* with clinical improvement. This lymphocytosis was not seen in fatal uncomplicated cases.

Mental and neurological abnormalities were frequently observed, but were not consistently associated with changes in the cerebro-spinal fluid.

In treatment, complete rest from the onset and the oral administration of adequate fluid were essential. Capable and painstaking nursing undoubtedly saved many lives. Convalescent serum was not used.

#### ACKNOWLEDGEMENT.

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#### ADDENDUM.

Scrub typhus has more recently occurred in areas other than those described above, and of a total of sixty patients admitted to this hospital within the eighth day of their illness, three have died. The serum calcium level was estimated in the case of seven "dangerously ill" patients and was below normal in every instance. The lowest level was 6.8 milligrammes *per centum* and the highest 8.8 milligrammes. Further investigations are proceeding.

#### OBSERVATIONS ON THE EPIDEMIOLOGY OF SCRUB TYPHUS.

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THE rickettsial diseases of man comprising the typhus group are probably of great antiquity, yet European epidemic typhus, periodically a world-wide pestilence and commonly a scourge of armies, was not recognized to be a distinct clinical entity until the middle of the nineteenth century.

Intensive study has since revealed that this disease is caused by *Rickettsia prowazeki* conveyed from man to man by the body louse. It is therefore fostered by conditions which at once accelerate the multiplication and facilitate the dispersion of the intermediate host—overcrowding in insanitary conditions, dirt, poverty, extreme cold, famine and war.

When the facts of the typhus syndrome and its aetiology, discovered by research in Central Europe, became more generally known, it was soon realized that various conditions clinically resembling classical typhus existed in many other parts of the world. These diseases had a variety of local names, and although in general conforming to one syndrome type, they presented individual characters differentiating them clinically from the classical form and from each other. They all, however, shared two features in common—they were caused by rickettsial infection and they were endemic or sporadic, not epidemic.

The number of these diseases to be clinically described grew rapidly, and with the development of elaborate refinements in laboratory technique, recognition of their aetiological affinity and knowledge of the specific nature, mode of transmission and special epidemiological features of each, were soon securely founded upon a mass of recorded clinical and experimental fact. It is now generally accepted that the typhus fevers may be classified on aetiological grounds into four main groups. Allocation of a particular fever to its proper group is assisted bacteriologically by the circumstance that the serum from animals infected with specific *Rickettsiae* gives different agglutination reactions against three varieties of *Bacillus proteus*—known as OX19, OX2 and OXK. The four groups are:

1. Louse-borne typhus, caused by *Rickettsia prowazeki*, epidemic in man and conveyed from man to man by the louse *Pediculus corporis*. The serum in this group agglutinates *Proteus* OX19.

2. Flea-borne typhus, caused by a variety of *Rickettsia prowazeki*, endemic in rats and conveyed by the rat flea



sporadically to man. The serum in this group agglutinates *Proteus* OX19.

3. Tick-borne typhus, caused by *Rickettsia rickettsi* in North America, and by certain so far unidentified species of *Rickettsia* in other countries, endemic in rodents and occasionally in dogs, and transmitted sporadically to man by various species of tick. Serum reaction differs in the various fevers.

4. Mite-borne typhus, caused by *Rickettsia orientalis*, endemic in rodents and transmitted sporadically to man by larvae of the mite *Trombicula deliensis*. The serum of affected persons agglutinates *Proteus* OXK; and this form, which includes scrub typhus of Malaya, Sumatran mite typhus and tsutsugamushi or river fever of Japan, is for this reason sometimes called K typhus.

On the basis of these discoveries, Zinsser has suggested that typhus was originally a rickettsial tick infection, which became epizootic and later enzootic in the rat. Conveyed sporadically from the rat to man by the rat flea, it became adapted to transmission from man to man by the body louse and assumed an epidemic role.

The existence of fevers of the typhus group in Australia has been suspected for many years, and reported from time to time.

Louse-borne typhus probably played a major part in the high mortality experienced in the second fleet in 1780, but the only Australian epidemic recorded occurred amongst convicts in Hobart, 1839-1840 (Burnet<sup>(1)</sup>).

Flea-borne typhus in Australia was first identified by Hone in Adelaide in 1920, and has since been reported at intervals from the grain belts and ports of Australia, more particularly in Queensland, South Australia and Western Australia.

One possible variety of tick-borne typhus has recently been shown by Derrick<sup>(2)</sup> (1937-1939) to be endemic in southern Queensland, where it is known as "Q" fever. The disease is enzootic in the bandicoot (*Isodon torosus*), infection being maintained by the tick *Haemaphysalis humerosa*. From the bandicoot infection may reach cattle and man by the agency of the scrub tick *Ixodes holocyclus* or the cattle tick *Boophilus annulatus*.

In regard to mite-borne typhus, for many years a number of unclassified fevers clumsily grouped together on clinical and epidemiological grounds as coastal fever, has perplexed physicians practising in northern Queensland. Study of these cases was beset with difficulties. They were few in number—perhaps three or four per year in any one locality—and sporadic in occurrence as to both time and place. The migratory habit of the population, the uncertainty of the incubation period, the doubt that the conditions constituted a single clinical entity, and the lack of laboratory facilities, all contributed to the difficulties of elucidating the true nature of these fevers. With the establishment of the Commonwealth Health Laboratories at Townsville and Cairns, progress in this direction, however, was rapid. In 1934 Morrissey,<sup>(3)</sup> Cotter and Sowers<sup>(4)</sup> identified Weil's disease as included in coastal fever, thereby contributing materially to the dispersion of the mists of confusion enveloping the group.

Meanwhile the work of Lewthwaite and Savor<sup>(5)</sup> in Malaya had again directed attention to the similarity existing between certain pyrexias of the coastal fever group and the typhus fevers of Japan, Malaya and Netherlands Indies. Unwin<sup>(6)</sup> (1935), Matthew<sup>(7)</sup> (1938) and Heaslip<sup>(8)</sup> (1938-1940) have since conclusively established the endemicity in northern Queensland of a typhus fever closely resembling the rural typhus of Malaya and tsutsugamushi of Japan. Contemporaneously Gunther<sup>(9)</sup> described an apparently identical condition in New Guinea.

Until recently, study of the epidemiology of this disease, now generally known as scrub typhus, has been seriously impeded by the wide spacing of case incidence in point of both time and place. Heaslip made a close study of all cases reported in northern Queensland over a two-year period of unusually high incidence. He was able to collect records of only 54 cases (of which ten are doubtful), and these originated in twenty different localities widely dispersed over a coastal strip some two hundred miles long.

An unprecedented opportunity to investigate large numbers of cases at one time and to study at first hand the epidemiology of the disease under more or less controlled conditions has been afforded medical officers of the Australian Military Forces by outbreaks amongst troops in Australia and New Guinea.

The ensuing discussion of investigations made during these outbreaks represents an effort to record, within the limits imposed by military security, the salient epidemiological features observed and the lessons these seem to teach.

In particular, three outbreaks furnished a considerable amount of information and served as controls each for the others. In the first, troops were engaged in mobile operations in heavily timbered country some 2,000 feet above sea level. In the second they were camped near the coast at sea level in open forest country. In the third they operated in a long broad open valley covered with kunai grass and pit-pit (water bamboo) and bounded by ranges, in part heavily timbered.

#### Outbreak A.

Three divisions operated for some months in heavily timbered jungle country at an elevation of some 2,000 feet. The jungle was broken by belts of open forest, kangaroo grass and kunai, intersected by steep banked mountain streams. Where the streams ran out of the jungle into the forest and kunai, they carried with them narrow belts of jungle vegetation confined to the immediate banks and the stream bed.

Practically all troops engaged in this area suffered in greater or less degree from scrub itch, which was known from previous experience to be widespread throughout the area. Mite surveys showed that the mite *Trombicula minor*, which causes scrub itch, was prevalent in extraordinary density in kunai grass and forest country, more particularly along the jungle fringes, throughout the area covered by one of the divisions, and to a less extent in the country in which the others moved. A high incidence of scrub itch was recorded amongst the troops as soon as the area was occupied. (Scrub itch is a term applied by soldiers in New Guinea to the irritation of the skin caused by numerous mite bites, usually on the trunk and lower limbs.)

A sharp outbreak of scrub typhus occurred in one brigade, in which 45 cases were reported over a period of four weeks. Investigation showed that infection was practically limited to two battalions operating in a particular area and within these battalions to companies patrolling a strictly limited locality. Detailed inquiry revealed the interesting fact that patrols taking different routes occasionally crossed at this spot, and bivouac or exercise here was the only common feature of epidemiological history in affected companies. Cases of typhus appeared in such patrols ten to fourteen days later, in some cases after a single visit. Companies whose patrols were limited to adjacent country escaped. The incidence in companies reported as using the site was high. Within the companies, incidence was confined to platoons which had bivouacked nearest the jungle fringe on a short section of the bank of a steep banked creek. Two patients subsequently reported from otherwise unaffected units gave a history of having visited this locality about twelve to fourteen days previous to onset.

#### Outbreak B.

A brigade group, camped in kunai forest along the banks of a small steep banked creek where the latter ran out of the foothills onto the coastal plain, suffered 37 casualties from scrub typhus in three weeks. Of these, 28 were exclusively from one battalion within this brigade. Most companies were affected, but in each company cases were drawn from men tented within fifty feet of the creek bank.

The outbreak was in cool weather, but cases did not occur until twelve days after the 9 a.m. temperature rose for the first time to 65° F.

Scrub itch was not reported in the area and mite surveys were unproductive.

### Outbreak C.

Two brigade groups operated in a long wide river valley of open kunai grass and pit-pit bordered by foothills clad with jungle and intersected by jungle-fringed mountain streams. Over a lengthy period some hundreds of cases occurred in units camped near the jungle fringes on the banks of the streams.

Units in the open kunai of the valley for the most part escaped scrub typhus, but those in certain localities in the foothills showed a high incidence.

### Conclusions Drawn from the Outbreaks.

Conclusions drawn from these outbreaks were as follows.

1. Scrub typhus infection is limited to very restricted foci, occurring with relative infrequency in extensive areas of apparently similar country.
2. Within the narrow foci involved, infection is intense.
3. The foci appear to be limited to areas on the banks of steep banked jungle-clad streams.
4. Infection persists at least some weeks in the foci.
5. An atmospheric temperature of 65° F. or over is necessary before inoculation will occur.
6. Incubation period ranged from ten to twenty-one days, with the average about twelve days.

Study of pre-war outbreaks in Australia and New Guinea has confirmed these findings and has added yet another.

7. Cases seem to reappear year after year from the infected foci.

### Reservoir.

Man is exclusively the reservoir of the *Rickettsia* of epidemic typhus and provides the only source of infection for the vector louse. For the *Rickettsia* of all forms of endemic typhus, rodents, and in particular the rat, serve as the reservoir, although in some Mediterranean, African and South American forms the dog as well is important in this capacity.

The incriminated reservoirs of scrub typhus are rats and field mice in Malaya, Sumatra and Japan, and the squirrel and woodchuck in North America.

For Queensland, Heaslip states that bandicoots and various species of rats are susceptible and have been found infected in nature. It is, however, difficult to appraise the value of Heaslip's work in this field, or to accept his conclusions without reserve. As evidence of the susceptibility of bandicoots, he records that five were inoculated with material from animals infected with *Rickettsia* or scrub typhus. Mice inoculated with blood withdrawn from these animals a week later all became infected "with *Tsutsugamushi*". Elsewhere Heaslip reports "typical *Tsutsugamushi*" proving fatal to mice inoculated with second passage eggs contaminated with *Bacillus tropicus*, and it is difficult therefore to assess the significance of "death from *Tsutsugamushi*" in his experiments with bandicoots.

In search of evidence of natural infection, Heaslip applied the Weil-Felix test to 49 bandicoots. Of these, thirteen gave low or equivocal agglutination of *Bacillus proteus* OXK, a finding not inconsistent with the hypothesis that these animals may be a natural reservoir. A confusing factor, however, is introduced by the circumstance that in one series of five bandicoots so tested, three from south Queensland, where scrub typhus is not known, all gave a Weil-Felix reaction against *Proteus* OXK, whereas two from the endemic area both gave negative results.

In this connexion Savor and Lewthwaite<sup>10</sup> insist that the Weil-Felix test is valueless in experiments with rats or rabbits as an indication of natural or artificial rickettsial infection, since these animals commonly harbour *Spirillum minus*, which of itself gives a Weil-Felix reaction with *Bacillus proteus* OXK.

Heaslip's transmission experiments, designed to demonstrate natural *Rickettsia orientalis* infection in bandicoots by inoculating mice with their blood, are invalidated by contamination of the inocula with *Bacillus tropicus*, the

clinical and pathological effects of which are not determined.

However, a personal communication from Lewthwaite and Savor records that a Queensland strain of *Rickettsia* recovered by Heaslip from a bandicoot proved to be identical with the two Malayan strains with which it was compared.

Evidence relating to rats is no clearer. As to susceptibility, Heaslip claims to have inoculated six different species of Queensland rats with scrub typhus, but the criteria used in determining successful infection are of questionable value. These criteria were: (a) Subsequent demonstration of *Rickettsia* in smears. Such demonstration given in one place as one positive result in 195 tests and elsewhere as 18 positive results in 90 tests would not necessarily mean that the infecting *Rickettsia* was *Rickettsia orientalis*. (b) "Death from *Tsutsugamushi* within the usual time" of mice inoculated from artificially inoculated rats. (c) Enlargement of the spleen in mice inoculated from inoculated rats. This criterion and that preceding it seem valueless in view of the statement that "infection with *B. tropicus*" was found in the majority of inocula used and at autopsy of the inoculated mice.

As to natural infection of rats, 51 of 195 rat sera examined are stated by Heaslip to have agglutinated *Bacillus proteus* OXK in titres "up to" one in 320—an unfortunately indefinite method of recording. Assumption on these grounds that rats may be infected in nature is not warranted. Even if it were, the value of the evidence so afforded would be largely nullified by the failure to correlate assumed infection to locality of trapping.

Animal transmission experiments to prove the natural infection of rats are once again vitiated by the intrusion of *Bacillus tropicus* and must be discarded for the reasons already stated.

On the whole it appears that bandicoots and several species of rat in Queensland show in a percentage of cases low titre agglutination of *Bacillus proteus* OXK, suggesting infection with *Rickettsia orientalis*. There is no evidence, however, that this feature of rodent pathology is in any way related geographically to the limited areas of scrub typhus infection in man. Evidence that bandicoots and rats are susceptible to inoculation with *Rickettsia orientalis* is unconvincing to the extent that alternative interpretations of the results recorded are many and obvious.

The epidemiology of scrub typhus in troops suggests that the vector meets the animal reservoir only near the banks of wooded streams. From this it may be inferred that there exists a similar restriction of habitat in either or both. It implies in the reservoir at least a semi-aquatic or jungle habit inconsistent with the diverse and widespread rodent incidence claimed by Heaslip.

### Vector.

Mites believed to be responsible for carrying scrub typhus infection from rodent to man are the six-legged larval stages of certain arthropods of the family Trombididae. These larvae are blood-suckers, feeding upon rodents, birds, reptiles and vicariously upon man. On its normal host the larva feeds about four days and then drops off, thereafter successively developing into nymph and adult. Both the latter stages are vegetarian. The female may produce 150 larvae in a fortnight and these themselves will be ovipositing within a month. Consequently in a suitable tropical environment the mite population is immense and widespread.

The larval mites attacking man set up, after some hours, considerable skin irritation which persists some days, even after removal of the mite. This condition is well known in northern Queensland as "scrub itch" and in New Guinea as "mokka bite".

It is believed that mites, infected during their larval parasitic stage upon a rodent reservoir and maturing into female adults, transmit infection through their eggs to the next generation of larvae. These in turn are able to transmit the *Rickettsia* of scrub typhus to susceptible animals or to man during the blood feed.

Evidence that the larval mite is in fact the intermediate host of rickettsial infection is circumstantial rather than experimental. Broadly it is based upon: (a) Rickettsial infection in certain rodents of the endemic area. (b) The very high population of a particular mite species upon such rodents. (c) Evidence that these mites attack man, the only certain criterion for this purpose being the occurrence in man of scrub itch produced by their biting.

To establish this beyond doubt as the route of infection for man or animal, it is necessary to breed second generation larvae and to demonstrate their infectivity for susceptible animals.

Japanese workers<sup>(4)</sup> have reported successfully accomplishing this in tsutsugamushi fever, but their work has not been confirmed for scrub typhus by other workers, who have found it impossible to rear larval mites in captivity. Walch and Keukenschrijver, however, in the Netherlands Indies successfully inoculated a gibbon with an emulsion of 400 crushed mites taken from rats. It is unnecessary to comment that this success does not establish beyond dispute transmission to man by a single mite bite in nature.

Keukenschrijver records the occurrence of Sumatran mite typhus in a coolie from whose scrotum he had removed a larval *Trombicula deliensis* three weeks earlier, a primary ulcer appearing on the part from which the mite had been taken.

In Japan, *Trombicula akamushi* is accepted as the vector of tsutsugamushi fever. In Sumatra, *Trombicula deliensis* is regarded as transmitting Sumatran mite fever, and in Malaya the same species is held responsible for infection of man with scrub typhus.

In Australia and New Guinea, a variety of vectors has at times been suggested, on the ground of predominant prevalence in different areas of endemicity. *Trombicula minor*, the common scrub itch mite of northern Queensland, was suggested as a vector in parts of New Guinea by Gunther, but is not accepted as an intermediary in Queensland by Heaslip, who believes *Trombicula deliensis* to be responsible there. *Trombicula deliensis* was not found by McCulloch in areas in which troops have been infected; indeed no single species of mite was particularly indicated in any area. In many areas of endemicity in New Guinea, McCulloch found a few *Trombicula fletcheri* and *Trombicula walchi* in association, though these were in few the predominant species, and in most but an insignificant minority. In at least one important area of endemicity they were not found at all.

The epidemiology of scrub typhus in Australia and New Guinea suggests no particular species of mite is indicated as the specific vector. In these countries no particular species of mite is conspicuously prevalent or even consistently found in all endemic areas, and it appears probable that all mites attacking man must be regarded with suspicion.

Remembering that the only certain evidence that a species of mite will attack man is its production of itch, there are indeed a number of contradictions to any species being the vector of scrub typhus:

1. Areas of scrub itch prevalence and of scrub typhus endemicity do not coincide. Scrub itch is almost universal in troops in certain areas; scrub typhus is definitely restricted and quite commonly occurs in areas where scrub itch is not reported.

2. In comparatively few cases of scrub typhus is scrub itch recorded as having occurred at a time prior to onset, consistent with the incubation period. Many patients emphatically deny ever having had scrub itch.

3. On the body, scrub itch in New Guinea at least is peripheral in distribution; the feet and legs are almost invariably affected. The trunk is never involved without the ankles and feet. In scrub typhus, by contrast, the eschar or primary lesion at the site of the infected bite is centripetal. In 374 cases at an Australian general hospital where distribution was recorded, the eschar was seldom found below the knee or elbow and in 92% of cases was confined to the trunk, arm or thigh.

4. Lesions of scrub itch are multiple, quite often beyond possibility of being counted. The eschar of scrub typhus,

on the contrary, is almost always solitary. Of 374 patients on whom eschars were observed, 98% had a single lesion only.

5. The bites of mites are irritable; the eschar of scrub typhus is painless and usually overlooked. Gunther endeavoured to explain this anomaly by assuming that multiplication of rickettsiae in the lesion anaesthetizes the nerve endings. Even if this assumption is accepted, it is difficult to explain why large numbers of men, smothered with scrub itch, can escape the solitary infected bite, when so many are infected without evidence of bite at all.

6. Mites multiply prolifically and rapidly, and, as evidenced by the mite causing scrub itch, have a widespread population of very high density. If Heaslip's estimate of the high infection rate in bandicoots and mixed species of rat is accepted, it is difficult to reconcile the migratory habits of these animals, the prolific multiplication, and the wide dispersion of vector mites, with the very restricted focal distribution of scrub typhus.

7. In the wide river valley to which reference has been made, mites and scrub itch were plentiful in the kunai and pit-pit of the river flats, but typhus apparently did not occur there. Mites, on the other hand, were not a problem in the jungle fringes on the banks of mountain streams, where the incidence of typhus was heaviest.

To reconcile these anomalies to the theory of mite-borne typhus, it must be assumed that: (a) the vector mite has a different distribution from the scrub itch mite, favouring jungle fringes on creek banks, rather than the open kunai preferred by the latter; (b) the vector in endemic foci is sufficiently infrequent to ensure only one infective bite per man, but numerous enough to infect an appreciable number of men in the same locality at any one time; (c) the mite is one preferring to feed on the trunk rather than on the extremities favoured by the scrub itch mite; (d) the bite of the vector is painless and non-irritating, in contrast to that of the scrub itch mite which is irritable.

Curiously enough, another arthropod, the tick, fulfils these postulates and must be considered a possible alternative vector. The tick is a scrub parasite feeding principally upon the trunk, and its bite is painless. It is not found in the overwhelming numbers characterizing the mite, and certain species may survive as larva, nymph and adult for three or more years without feeding more frequently than once a year. The tick has therefore two other attributes as a possible vector of scrub typhus not possessed by the mite: (a) It can survive in an infective condition in one locality for months or years without concomitant multiplication, and dispersion of infection by several generations. (b) It belongs to a family of arthropods experimentally proved elsewhere to be capable of transmitting rickettsiae from animal to man.

Evidence as to the painlessness of the tick's bite is not lacking, for troops have not infrequently been parasitized by these arthropods. In almost all such instances attention has been drawn to the tick by visual means when bathing, and usually by comrades.

Objection that the tick is large, takes some time to engorge, is difficult to remove, and therefore not likely to be overlooked, is in some measure offset by the fact that adult ixodid ticks rarely voluntarily attack man. The larvae, on the other hand, will much more frequently do so and are known to be capable of transmitting rickettsial infection in America and in Africa. These larvae are small and inconspicuous. Even if seen they would probably be mistaken for mites, as has, in fact, not infrequently occurred.

Recently Smith<sup>(5)</sup> has shown that *Hemaphysalis dispinosa*, which as larva and nymph is an effective laboratory vector of "Q" fever, fails to transmit infection to laboratory animals as an adult. This failure he attributes to the fact that the adult feeds reluctantly and does not engorge. If his explanation is accepted, it would be rational to assume that larval stages of an ixodid tick might convey scrub typhus from reservoir to man, even in the absence of evidence against the adult.

No particular inquiry appears to have been made from scrub typhus patients in Australia and New Guinea to elicit a history of tick bites. It is perhaps not without



Type of Typhus.	Primary Lesion.	Adenitis.	OXK.	OX2.	OX19.	Neill Mooser Reaction.	Occurrence.
Louse-borne	—	—	—	—	+++	—	Domestic.
Flea-borne	—	—	—	+	++	—	Urban.
Tick-borne (Africa)	+	+	++	++	++	—	Rural.
Australia and New Guinea	+	+	+++	++	—	—	Rural.

significance that in Heaslip's series four patients with typhus from one camp, whilst emphatically denying mite infestation, recorded biting by ticks.

Most Australian general hospitals in the field have reported cases of paresis and paralysis of unknown origin. It is conceivable that these may in fact be tick paralyses and point to unrecognized tick biting.

Further support for the tick as a possible vector is afforded by comparison of the differential characters of some forms of typhus occurring elsewhere in the world. The accompanying table sets out certain characters of each type.

It is clear that there is an apparent affinity between typhus as known in Australia and New Guinea and the tick-borne form of Africa.

In New Guinea, ticks taken from rodents haunting the vicinity of endemic foci have included a so far unidentified species of *Haemaphysalis*. Species of *Haemaphysalis* have been proved vectors of African tick-borne typhus, infection being transmitted through four generations.

In the Bulolo Valley, always mite infested, scrub typhus was not reported until some months after the first introduction of cattle.

In Papua and New Guinea, sporadic white settlement has introduced cattle to only a few widely separated localities sharply delimited by natural barriers. The intervening terrain, where cattle have never been depastured, includes much of similar character to that used for grazing. It includes innumerable jungle-fringed streams of the type with which scrub typhus seems to be associated, and it embraces extensive areas of heavy mite infestation.

It appears to be of some significance, then, that with heavy concentrations of troops in various parts of the island, scrub typhus endemicity has been limited to the basins of streams on which cattle formerly ran.

Possible explanations of these epidemiological features are that a vector tick has been introduced by the importation of cattle, and that disappearance of the cattle under war conditions has left a large larval tick population inadequately provided with natural hosts.

It may be concluded that the tick must be considered a possible vector of scrub typhus in Australia and New Guinea. Determination of its suitability as an intermediary host is of more than academic interest, inasmuch as incrimination of the tick may lead to the discovery of an effective repellent and possibly afford an opportunity for the preparation of a protective vaccine. Vaccines prepared from species of *Dermacentor* have been successfully used in the prophylaxis of the American form of tick-borne typhus.

#### Summary.

The lessons to be learned from outbreaks of scrub typhus in Australian troops are considered. It may be concluded that:

1. Endemicity of scrub typhus is restricted to small foci of high infection widely separated from each other even in apparently similar terrain. These foci show an association with jungle-fringed streams.
2. Infection of man takes place only at atmospheric temperatures over 65° F.
3. The usual incubation period is about twelve days.
4. There is no indication of the animal reservoir beyond the fact that it is probably an animal of semi-aquatic and jungle habit. It is highly improbable that the wide diversity of rodents suspected by Heaslip serves as a reservoir for the infection of man.
5. There is no evidence to incriminate any one particular species of mite as the specific vector. It does, however, appear that the mites causing scrub itch are not concerned.

6. The epidemiology of scrub typhus is consistent with its transmission by larval ixodid ticks and the desirability of inquiry in this field is indicated.

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#### References.

- (1) F. M. Burnet: "The Rickettsial Diseases in Australia", THE MEDICAL JOURNAL OF AUSTRALIA, August 22, 1942, page 129.
- (2) E. H. Derrick: "Q Fever, a New Fever Entity: Clinical Features, Diagnosis, Laboratory Investigations", THE MEDICAL JOURNAL OF AUSTRALIA, August 21, 1937, page 281.
- (3) G. C. Morrissey: "The Occurrence of Leptospirosis (Well's Disease) in Australia", THE MEDICAL JOURNAL OF AUSTRALIA, October 13, 1932, page 496.
- (4) T. J. P. Cotter and W. C. Sawers: "A Laboratory and Epidemiological Investigation of an Outbreak of Well's Disease in Northern Queensland", THE MEDICAL JOURNAL OF AUSTRALIA, November 10, 1934, page 597.
- (5) R. Lewthwaite: "Clinical and Epidemiological Observations on Tropical Typhus in the Federated Malay States", "Bulletin Number 1 of 1930 from Institute for Medical Research, F.M.S."; "Experimental Tropical Typhus in Laboratory Animals", "Bulletin Number 3 of 1930 from Institute for Medical Research, F.M.S.". R. Lewthwaite and S. R. Savor: "Recent Work on the Typhus-like Fevers of Malaya", *Transactions of the Royal Society of Tropical Medicine and Hygiene*, Volume XXIX, April, 1936, page 561.
- (6) M. L. Unwin: "Coastal Fevers and Endemic Tropical Typhus in North Queensland: Recent Investigations, Clinical and Laboratory Findings", THE MEDICAL JOURNAL OF AUSTRALIA, September 7, 1935, page 303.
- (7) R. Y. Matthew: "Endemic Typhus in North Queensland", THE MEDICAL JOURNAL OF AUSTRALIA, September 3, 1933, page 371.
- (8) W. G. Heaslip: "Tsutsugamushi Fever in North Queensland, Australia", THE MEDICAL JOURNAL OF AUSTRALIA, March 29, 1941, page 330.
- (9) C. E. M. Gunther: "Endemic Typhus in New Guinea", THE MEDICAL JOURNAL OF AUSTRALIA, June 29, 1935; "A Survey of Endemic Typhus in New Guinea", *ibidem*, November 30, 1940, page 564.
- (10) S. R. Savor and R. Lewthwaite: "The Well-Felix Reaction in Experimental Rat Bite Fever", *The British Journal of Experimental Pathology*, Volume XXII, 1941, page 274.
- (11) Nagayo et alii: *Transactions of the Japanese Pathological Society*, 1924.
- (12) D. J. W. Smith: "Studies in the Epidemiology of 'Q' Fever. II. Experimental Infection of the Ticks *Haemaphysalis bispinosa* and *Ornithodoros* sp. with *Rickettsia Burneti*", *The Australian Journal of Experimental Biology and Medical Science*, Volume XX, December, 1942, page 295.

#### NOTES ON THE HABITS AND DISTRIBUTION OF TROMBICULID MITES IN QUEENSLAND AND NEW GUINEA.

By R. N. McCulloch,  
Major, Australian Army Medical Corps.

#### Life History: Method of Collecting Larval Mites.

MITES of the family Trombiculidae are pests causing itch on human beings in many parts of the world, and are known by a variety of names, such as harvest mites (Britain), chiggers (United States of America), akumushi (Japan), ti-tree itch (South Australia), scrub itch (Queensland), and mokkas (New Guinea).

In the form in which these mites attack man and other animals they are six-legged larvae resembling minute red spiders 0.2 to 0.3 millimetre in length. They live in the soil waiting for a host animal, from which they get the blood-feed essential for their development. In seeking a feed, the blood-hungry mites crawl onto a host, attach

themselves like a tick by forcing their straight barbed chelicerae into the skin, and remain attached until fully fed. In some species at any rate, engorgement takes about two days. When fully fed the larvæ return to the ground and develop into the eight-legged adults as (probably) vegetarian inhabitants of the soil. The females, which lay eggs from which the larvæ hatch, are two to three millimetres long, red or cream-coloured, and with a median constriction giving their body the shape of a figure 8. The adults of the great majority of species are as yet unknown.

Trombiculids have been studied for the most part as larvæ parasitic on animals—rodents, marsupials, reptiles, birds. In the course of recent experiments with mite repellents, some observations have been made on their behaviour as unengorged larvæ seeking to attack man.

Clothing impregnated with any one of a number of insecticides can protect experimenting personnel from mites which crawl on the boots. Accordingly the technique of collecting consisted of standing still in suspected situations, and taking up the mites as they crossed the boots, by using a camel-hair brush and alcohol. After a little training this is a simple operation; though where mites are scarce it may be necessary to stoop over one spot for fifteen minutes before seeing one. On the boots they appear as tiny moving orange specks. The speed of some species is surprising, individuals travelling one inch in three or four seconds.

Much of the material collected has been identified by Mr. H. Womersley, of the South Australian Museum; but at January, 1944, a considerable number of collections had not been classified.

#### Observations in North Queensland.

##### Species Concerned: Distribution.

North Queensland "scrub itch" is apparently caused almost exclusively by *Trombicula minor* Berlese, which occurs in enormous numbers in some parts of the Atherton Tableland. Here, in the autumn of 1943, it was often possible to have 100 mites on one's boots at a time, all crawling rapidly upward to disappear under one's gaiters. Scrub typhus occurred among the troops on the tableland, though the number of cases was very low in relation to the incidence of itch. It was possible to trace the infection to a limited number of fairly well-defined small areas. In one of these, specially surveyed for mites, among the very heavy population of *Trombicula minor*, odd specimens of *Leemuenhoekia hirsti* Womersley (MS.) and *Neoschöngastia melomys* Womersley were found.

According to popular belief, scrub itch is to be picked up in the tropical rain forests ("scrub"), and is particularly associated with rotting logs. In these investigations, mites could rarely be found in the dense scrub or, at the other extreme, on cleared grass land. Typical habitats in which large numbers were found were: (a) a belt, a few yards wide, along the scrub edge; (b) tracks or small clearings in the scrub, where grass grew weakly or not at all; (c) under trees or bushes in open savannah or cleared scrub land, where the shade was sufficient to interfere markedly with grass growth—cleared scrub land, neglected and overgrown with wild tobacco, was particularly liable to be mite infested. Rotting logs appeared to be of no importance in the picture.

When stimulated by the presence of a prospective host, mites will leave the soil in which they live and climb grass and twigs, rarely, however, venturing more than about three inches from the ground. Although they are not seen on the tops of old logs, a new article, such as a box, placed among them would generally have a few mites crawling over it after a minute or two had elapsed.

##### Effect of Temperature and Weather on Mite Activity.

In autumn and early winter, when the observations on the Atherton Tableland were carried out, mites were most active on warm, dry days. They showed great activity at a shade temperature, on the grass, of 67° to 75° F., reduced activity at 65° F., and were almost completely inactive at 60° F. Mites kept in glass tubes were completely motionless at 50° F., rapidly recovering full activity when

warmed to 70° F. At night, when not controlled by temperature, their activity was equal to that by day. In mid-June, after a week of cold weather with a shade temperature of 40° to 75° F. on the grass during the day, mites disappeared almost completely.

Timber workers on the tableland consider the thunderstorm season at the end of the year "worst for scrub itch".

##### Effect on Man.

Mites crawling on the skin are not felt, except on the face, ears and scalp. After attachment, they are not noticed for ten to eighteen hours, when itch usually begins. A small, red, raised area of skin about a quarter of an inch in diameter appears; and in the middle of it the mite, if not scratched out, may be seen. The itch is more obvious when one is in bed, and is stimulated by rubbing or scratching. If not scratched, the lump usually ceases to itch in four to five days. A small number of bites causes no serious worry, although the typical individual lesions are still present; but many hundreds, especially if added to day after day, cause intolerable itch. Scratching usually removes the mite with a piece of skin, and often leads to secondary infection.

The violent reaction set up suggests that man is not a normal host. Rats can have hundreds of mites in various stages of engorgement attached to their ears or scrotal area and remain apparently unaffected. On man, mites are hard to find twenty-four hours after exposure, although bites may be numerous. On the day of exposure, before itch develops, hundreds of mites may often be found on one man, though the search for them is often a slow process, as at this stage no red bite marks have developed to lead one to the parasite.

Washing with cool water and soap, followed by normal drying on a towel, removes very few, if any, attached mites. Removal by needle three or four hours after attachment does not prevent the development of an itch spot.

##### Part of Body Attacked.

Troops exposed to scrub itch on the Atherton Tableland were bitten all over the body where clothing covered the skin, and extremely rarely in such places as the bend of the elbow (sleeves rolled up), behind the ears and in the folds about the eyes. Biting was not more heavy about the ankles, waist and armpits than elsewhere. (In New Guinea, in contrast, ankles are the parts most heavily attacked. Possibly sweat on the skin favours attachment; and in New Guinea the ankles, as a rule the first part to be reached by the mites, are usually sweaty.) The fact that mites usually reach the body by way of the feet does not prevent biting of the trunk, though trunk biting has sometimes been advanced as evidence that mites may drop from trees or be picked up by brushing against foliage. Men standing, cool, on mite-infested ground have been bitten most extensively on the trunk.

#### Observations in New Guinea.

##### Species Concerned: Distribution.

Womersley and Heaslip, writing in the *Transactions of the Royal Society of South Australia* in 1943, record some twenty-four species of trombiculids from New Guinea. That there remain many unnamed is indicated by the fact that of about twelve species collected at Dobadura, six were new. As some areas had a history of scrub typhus without recorded itch, while in others (as at Atherton) there was a great deal of itch and little typhus, it was obviously desirable to collect evidence as to which species might be the vectors of the disease.

At Donadabu (some twenty miles from Moresby), an area with a clear history of typhus infection had a very light population of mites, predominantly *Trombicula fletcheri* Womersley and Heaslip and *Trombicula walchi* Womersley and Heaslip, with odd individuals of *Schöngastia*, *Neoschöngastia* and *Guntherana* spp. In all, some sixty mites were collected on the boots of six men in half a day, within 100 yards of a central spot. It is felt that a relatively high level of rickettsial infection in this population could explain the typhus outbreak and,

at the same time, the failure of the troops concerned to complain of, or afterwards remember, any itch.

At Dobadura (near Buna) much itch and some typhus occurred during the establishment of camp sites. Of 400 to 500 mites collected from man, some 80% were *Schöngastia pusilla* Womersley (MS.), 15% were *Schöngastia blestowei* Gunther, and the remainder were *Trombicula minor*. Several species of *Trombicula*, including *Trombicula fletcheri* and *Trombicula walchi*, were also collected in the area, while the genera *Neoschöngastia*, *Guntherana* and *Lecuwenhoekia* were represented.

At Buna, where there was typhus but little or no itch, *Trombicula fletcheri* and *Trombicula walchi* were the most numerous species in a very light mite population.

At Nadzab (lower Markham Valley), in kunai country with a history of some typhus, only *Trombicula fletcheri* and a species of the *Trombicula minor* group could be found, and in very small numbers.

Thus far, New Guinea observations would seem to incriminate *Trombicula fletcheri* and *Trombicula walchi*, which are very closely allied to *Trombicula deliensis*,<sup>1</sup> the accepted vector of scrub typhus in many south-west Pacific countries. At Dumpu (Ramu Valley), however, *Schöngastia blestowei* alone was more clearly indicated as the vector (as well as the cause of itch) than was any other single species elsewhere. It was found almost everywhere in the grass country of the valley, nearly always without other species; and in several camps with a history of typhus it alone was found after most careful searching.

It would seem that any species of mite attacking man in New Guinea must, on our present knowledge, be regarded as a potential source of typhus infection.

It has been suggested that there is a "typhus mite", distinct from an "itch mite", which prefers to attack the trunk rather than the legs, and which has a bite that does not cause itch. To date no observations have been made on site preference for biting of different species; but it seems most unlikely that a trombiculid could bite man without causing itch, when such diverse forms as *Trombicula sanboni* in South Australia, *Lecuwenhoekia* sp. in the Sydney district, *Trombicula minor* at Atherton, and *Schöngastia* spp. at Dobadura, as well as many species in other countries, all cause similar irritation when biting in sufficient numbers.

#### Habitat.

In much of the country surveyed in New Guinea it has not been possible to foretell with any degree of accuracy where mites are likely to occur or be most numerous. At Donadabu, they appeared to be thinly distributed over the grassed hills, but could not be found in jungle. In the Buna-Dobadura area they were not found in coconut plantations heavily choked with grass and fern, and they were extremely rare in sago swamps. One was likely to find the richest patches (which would be predominantly *Schöngastia pusilla*) in jungle; but they would sometimes be almost equally numerous in grass. *Trombicula fletcheri* and *Trombicula walchi* were taken only in grass; but other species were found in both grass and jungle. There was no clearly defined mite belt along the scrub edges, as was so noticeable at Atherton. At Dumpu, *Schöngastia blestowei*, found almost everywhere in the grass of the main valley below about 1,500 feet, was notably rare in the patches of jungle.

From the above it would appear that camp site selection has little to offer as a means of avoiding scrub typhus. Men with some training could avoid obviously thick patches of mites, and thus the heaviest attacks of itch; but when troops are moving, the time spent in discovering a suitable site would probably not be justified.

#### Mite Behaviour.

Observations were carried out at Dobadura, and can be taken to apply to *Schöngastia pusilla*. In a heavily infested patch, mites were much more active after rain than actually during rain, or on the rare occasions when the ground was dry. When stimulated by the presence of

<sup>1</sup> *Trombicula deliensis* Walch has been found abundantly on mammals by Gunther at Wau and Heaslip at Cairns, but to January, 1944, in the present surveys had not been taken in New Guinea.

human bodies, they moved freely about the surface litter, but, as at Atherton, rarely climbed more than three inches up grass or bushes.

Mites confined in glass tubes and kept in the shade were usually dead in four to six hours; though with added damp blotting paper they survived for two to three days. During these tests daily temperatures were:

Minimum (6 a.m.): dry, 75° F.; wet, 73° to 74° F. (91% to 96% R.H.).

Maximum (2 to 3 p.m.): dry, 85° to 88° F.; wet, 78° to 80° F. (64% to 80% R.H.).

More recently, at Lae, *Schöngastia blestowei* collected on the boots and transferred to moist soil in test tubes have survived for as long as forty-six days. This and several other species of *Schöngastia* and *Paraschöngastia* examined in the field at night were fully as active as by day.

From their observed behaviour, it would seem safe to conclude that a man walking on infected ground would be bitten little or not at all; while to stand, sit or lie among mites, at night or by day, gives them the opportunity they require. Contrary to popular opinion, grass cut and dried and used for bedding probably carries with it no mites.

#### Camp Site Treatment.

It is impossible to cite an instance in which the specific treatment of a camp site has abolished itch; though, in general, the "civilization" of an area is followed by a marked reduction in itch, and also in the incidence of typhus. It is the usual practice to cut and burn kunai about tents and buildings, and to keep it cut. This probably reduces mite numbers by allowing the surface soil to dry and discouraging ground animals; but it does not get rid of the mites. At a general hospital at Dobadura, after a particularly heavy grass cover was burned off, twice-weekly searches for mites, carried out for a month, were invariably successful. Mites were even found the day after the burn. During subsequent months mites were still present, though the grass was cut at intervals. In a jungle camp that had been used as a headquarters for eight months, mites could still be found at the feet of the trees among the buildings, although ground litter was raked up and burned twice a week. Mites very quickly disappear, however, from paths and trampled ground, and from the floors of tents and buildings.

#### Acknowledgement.

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## Reports of Cases.

### A RARE CONGENITAL ABNORMALITY OF THE PULMONARY VEINS AND HEART.

By PHYLLIS M. GRAHAM,

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ALTHOUGH congenital malformations of the heart and great vessels occur in about 1.2% of all cases of cardiac disease,<sup>(1)</sup> it would appear that none similar to that now to be described has previously been recorded.

It is to be regretted that the nature of the cardiac deformity was not appreciated in the early stages of the post-mortem examination, and that, in consequence, in the attempt to unravel the structure of the heart, so much mutilation of the viscus occurred that no satisfactory photographic record of the anomaly could be obtained. The lack of any investigation of the physiology of the circulation during life is equally to be regretted.

#### Clinical Record.

A female child, aged eight months, was admitted to Sydney Hospital on June 10, 1944, and died in the hospital on June 13. The baby weighed six pound seven ounces at birth and was cold and cyanosed. For the first eleven days she was tube fed and required oxygen before and after each feed; at twelve days she began to suck feebly and after three weeks the mother took her home.



At home the baby fed poorly and failed to gain in weight satisfactorily. Her mother noted that she always breathed rapidly, and that any exertion caused her to fall back "gasping for breath". A cough was present from birth; cyanosis appeared only after strenuous crying. Occasional convulsive seizures occurred in the first few months, and these became more frequent during the two weeks prior to her admission to Sydney Hospital. For a short period the baby was in the Royal Alexandra Hospital for Children, where bronchitis and congenital heart disease were diagnosed. Except for this the mother was able to care for her at home until June 10, when she came to Sydney Hospital.

On her admission to hospital, the infant weighed eleven pound; she was distressed and cyanosed. The heart was grossly enlarged, the pulse rate was 160 per minute, and the temperature was 98.4° F. On June 13 she died. There was nothing in the detailed history of the mother's pregnancy which would suggest any possible aetiological factor, such as a rubella-like exanthem.

#### Autopsy Findings.

The heart was grossly enlarged, the enlargement being due to great hypertrophy of the right side with superimposed dilatation. There was a displacement of the interatrial septum to the left. The pulmonary veins entered the right atrium by a small common vein whose opening lay high up on the posterior wall just to the right of the septum, which lay in an oblique plane directed forwards and to the right. The *foramen ovale* was patent and measured four millimetres in diameter; the anterior lip of the foramen was thickened. The superior and inferior *vena cava* entered the right atrium in their normal positions.

Great hypertrophy of the right atrial wall was present, and the cavity was considerably enlarged. The left atrium was very small and its wall was thin. The right ventricle was hypertrophied, the wall measuring seven millimetres in thickness, while the left ventricle was hypoplastic, its wall measuring two millimetres in thickness. The inter-ventricular septum was complete and all the valves were perfectly developed. The *ductus arteriosus* was obliterated.

The lungs showed histological evidence of chronic venous congestion which was not complicated by any appreciable fibrosis. There were a few areas where the microscopic appearances of the alveoli suggested the inhalation of milk or other lipid-containing material. The changes did not appear to be sufficient to cause any interference with gaseous exchanges.

#### Discussion.

The primary differentiation of the primitive cardiac tube into separate chambers occurs in the first four weeks of gestation; it is during this very early period that the above malformation must have occurred. The cardiac tube early differentiates three cavities—the *bulbus cordis*, the ventricle and the atrium—the atrio-ventricular endocardial cushions grow out from the walls of the tube and separate the primitive atrium from the ventricle, while the *septum primum* develops as a fold from the dorsal wall of the atrium and approximates to the developing atrio-ventricular cushions. By a considerable difference in the rate of growth of the two sides of the atrium the opening of the *sinus venosus* comes to lie on the right side of the mid-line and thus on the right side of the *septum primum*, as the *sinus venosus* is drawn into the pericardium. The *septum secundum* grows on the right side of the *septum primum*, and as the *septum primum* fuses with the atrio-ventricular cushions, the *foramen secundum* appears in the *septum primum*.

Normally a small common pulmonary vein enters the primitive atrium just to the left of the developing *septum primum*. This vein enlarges; the venous cavity takes up the right and left branches and the next two branches on each side come to open directly into the cavity; this development of the pulmonary veins pushes the original atrial cavity upwards and to the left. The adult left atrium is thus developed from the dilated pulmonary veins, while the original fetal left atrium is represented by the auricular appendix in the adult.

In the case described some slight irregularity in the rate of growth of the different parts of the primitive atrium and a malformation of the septum have caused the common pulmonary vein to enter to the right of the developing *septum primum* instead of to the left. No true left atrium has therefore developed, and the rudiment representing the left atrium is that part of the primitive left atrial cavity which would normally have been pushed to the left by the developing pulmonary vein and persisted as the appendix. The child lived for eight months and was evidently cyanosed only on exertion. The entire venous return entered

the right atrium, and the only communication with the left side of the heart was through the patent *foramen ovale*. It is reasonable to assume that the blood returning from the lungs was well oxygenated, and it is probable that the pressure in the pulmonary circuit was raised. Such was the disposition of the apertures opening into the right atrium that the oxygenated pulmonary blood entered high up on the posterior wall just to the right of the interatrial septum. The septum and *foramen ovale* were so placed in relation to the pulmonary vein that the stream of blood returning from the lungs would pass through the *foramen ovale* into the left atrium, while the blood from the *vena cava* would tend to take its normal course through the tricuspid valve.

There would be considerable intermingling of the oxygenated and unoxygenated blood, so that at all times the oxygen saturation of the blood entering the systemic circulation would be less than normal. When any demand for an increased circulation arose, the response would be limited by the volume of blood able to pass through the *foramen ovale*. Increased metabolism as the result of muscular exertion could be met only by greater abstraction of oxygen from the blood in the systemic capillaries, and so a greater unsaturation of the capillary blood would follow and cyanosis would result. The corresponding increase in the venous carbon dioxide tension would cause dyspnoea by the usual mechanism, but its effect would be accentuated reflexly by pulmonary congestion secondary to a rise of pressure in the right atrium and by the partial mixing of the blood from the *vena cava* with that from the pulmonary circuit, which would augment the pressure of carbon dioxide in the arterial blood passing to the brain stem and carotid sinus receptors. The convulsive seizures are to be explained by a temporary anoxia of the brain.

The musculature of the left ventricle was poorly developed and its cavity small, while the right atrial musculature was grossly hypertrophied. It is possible that the right atrium was pumping the blood through both the left atrium and the left ventricle, forcing open the aortic cusps and providing the energy for the maintenance of the systemic circulation.

#### Summary.

1. A rare malformation of the heart in a child living to the age of eight months is described.
2. The embryology and the dynamics of the circulation in this case are briefly discussed.

#### Reference.

- (1) P. D. White and T. D. Jones: "Heart Disease and Disorders in New England", *American Heart Journal*, Volume III, 1928, page 302; quoted by Maude E. Abbott, "Congenital Heart Disease".

## Notes on Books, Current Journals and New Appliances.

### A BOOK ON DIAGNOSIS AND TREATMENT.

EVERY year *The Medical Press and Circular* issues a book on modern treatment in general practice. The volume for 1944 has been published.<sup>1</sup> The work which is intended for the general practitioner is edited by Dr. C. P. G. Wakeley. It is divided into two sections—one dealing with general medicine and surgery and the other with war medicine and surgery. Some subjects in these sections are, of course, suitable for either section. In the first section are articles on such subjects as coronary artery disease, uterine prolapse, congenital hypertrophic stenosis of the pylorus, carcinoma of the cervix, ulcerative colitis, carcinoma of the rectum, chorea, rupture of the male urethra, epilepsy, renal calculi, vaginal discharge, hazards of the neonatal period, carbuncle, measles, rheumatic disease, malaria and so on. In the second section are general articles on wounds of different organs and regions and others on piles in recruits, diet of miners and of factory workers, skin disease, rehabilitation, venereal disease and epidemic dysentery. The list of authors contains many well-known names. This book will find appreciative readers as others in the same series have done in the past.

<sup>1</sup> "Modern Treatment in General Practice Year Book, 1944: A Year Book of Diagnosis and Treatment for the General Practitioner", edited by Cecil P. G. Wakeley, C.B., D.Sc., F.R.C.S., F.R.S.E., F.A.C.S., F.R.A.C.S. (Hon.); 1944. London: The Medical Press and Circular. 8½" x 5½", pp. 308, with illustrations. Price: 16s.

## The Medical Journal of Australia

SATURDAY, NOVEMBER 18, 1944.

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### THE ADMINISTRATION OF CONTRAST MEDIA: A RECENT FATALITY.

ATTENTION has recently been drawn to the risks associated with the injection of contrast media into the human body by the sudden death of a patient following the intravenous administration of a contrast medium known as "Per Abrodil Forte" in the rooms of a Sydney radiologist. The patient, a man, aged fifty years, was under the care of a urologist who decided that a pyelogram was necessary if the patient's condition was to be elucidated. It should perhaps be mentioned that an electrocardiographic examination of the patient had been carried out about two years before and no abnormality was revealed. The urologist referred the patient to a radiologist, who proceeded to make preparations for the necessary examination. An intravenous injection of "Per Abrodil Forte" was given in the usual way, and about five minutes later the patient vomited and showed signs of collapse. Despite the injection of "Coramine" and the institution of artificial respiration, he failed to recover and died fifteen minutes after the intravenous injection. The death was reported to the coroner and a post-mortem examination was made. Coronary sclerosis and fatty degeneration of the cardiac muscle were found, and the finding was: "Death from fatty degeneration of the heart with heart failure following the intravenous injection of 'Per-Abrodil Forte'."

Although attempts were made in 1923 to visualize the renal tracts after the oral and intravenous administration of large doses of sodium iodide, it was not until organic iodine compounds were introduced by von Lichtenberg in 1929 that what is known as intravenous urography, or preferably excretion urography, became a recognized procedure. The greatest objection to the use of iodine in its free form was that it was not well tolerated and that sufficient concentration of the drug could not be obtained in the urine for the production of good urograms. In an article on the pharmacological actions of some contrast media and a comparison of their merits, published a little

more than two years ago, M. Weatherall states<sup>1</sup> that the compounds used at first, "Abrodil", "Tenebryl" and "Uroselectan", possessed certain disadvantages—they were not very opaque or very soluble, and therefore large volumes had to be used if good pyelograms were to be obtained. These compounds have therefore been replaced by the more satisfactory substances that are in common use today. These are: (a) diodone, which is sold under the names "Per-Abrodil", "Diodrast", "Pyelosil" and "Pylumbrin"; (b) iodoxyl, which is the pharmacopoeial name of the substance sold as "Uroselectan B", "Neo-Iopax", "Pyelectan" and "Uropac"; and (c) sodium o-iodohippurate, sold as "Hippuran". Weatherall carried out experiments which showed that diodone was the most suitable medium for pyelography, cardiography and angiography. He stated that diodone alone of all the drugs investigated by him was not a depressant and that the substances in all three groups dilated the coronary vessels. As they all contained organically bound iodine and otherwise had no close chemical relationship, he thought it possible that the action depended on the iodine, but pointed out that proof was lacking because the effect of the corresponding iodine-free substances was unknown. That the injection of these contrast substances into the body has sometimes been attended by unfavourable sequelæ has naturally caused much concern and the nature and frequency of these sequelæ have been studied. The survey reported by E. P. Pendergrass, G. W. Chamberlin, E. W. Godfrey and E. D. Burdick in 1942<sup>2</sup> is possibly the most extensive of its kind. The survey was based on replies to a questionnaire from 725 radiologists and 323 urologists. The total number of reports was 1,048, containing information on 661,800 urographic examinations. Though we are concerned mainly with deaths following the injection of these contrast media, it must be pointed out that a variety of symptoms may occur. It would be surprising if this were not so. Some kind of reaction would be expected, even with persons who were perfectly well, but those to whom the injections are given are suffering from some ailment, and it is usually one that affects the renal or the circulatory system. Pendergrass and his co-workers found that mention was made in nearly all replies to the questionnaires of one or more of the following symptoms: flushing, nausea, vomiting, urticaria (local and generalized), itching, venospasm, pain in the shoulder, sense of constriction in the larynx, phlebitis, unconsciousness (occasional), tetany and cerebral irritations. It was impossible to calculate the incidence. Some contributors stated that distressing symptoms occurred even when the drug was given by mouth and failed to produce a reaction to the test ("when the oral test has been regarded as negative"). Among the 661,800 examinations covered by the report there were twenty-six deaths, an incidence of 0.0039%. Ten of these were classified as immediate and four as delayed. The immediate deaths followed intravenous injection of "Diodrast", and most of them were preceded by symptoms simulating those of anaphylactic shock, "although the deaths may not have been due to an 'anaphylactoid reaction'". In other cases it was thought that overdosage might have been the cause of death. The contrast medium had not been proved to be the etiological factor in the delayed deaths. No immediate deaths were

<sup>1</sup> The British Journal of Radiology, May, 1942.

<sup>2</sup> American Journal of Roentgenology, December, 1942; abstracted in "The 1943 Year Book of Radiology", page 217.

reported following retrograde pyelography with any of the contrast media. In addition to the cases elicited by the *questionnaire*, Pendergrass and his colleagues found in the literature reports of ten fatalities, seven of which "evidently represented sudden death of the anaphylactic type".

With information of this kind before them, the members of the Australian and New Zealand Association of Radiologists at a recent meeting in Melbourne discussed the Sydney fatality. The members were asked whether they had had any similar experience. No deaths were reported with the use of "Per-Abrodil", although some 37,000 phials of the drug have been sold and used in the Commonwealth, but some severe reactions were recorded. These varied from pallor to vomiting, sweating and collapse. Two deaths were known to have occurred in Australia following the use of media which did not belong to the diodone group. From the findings in the Sydney case it does not appear that death can be attributed to hypersensitivity—the association of advanced pathological changes in the heart with a drug capable of producing severe symptoms in a relatively healthy person might cause a profound disturbance resulting in death. The radiologists at Melbourne were of the opinion that no sensitivity test could prevent mishaps when severe cardiac and other lesions were present, and a similar opinion has been expressed in "The 1942 Year Book of Radiology". In the Sydney case it must be presumed that great deterioration of the cardiac vessels and musculature occurred in the two years that elapsed between the taking of the normal cardiogram and the fatal injection. For the future it should be clearly stated and generally understood that the practitioner who sends a patient to a radiologist for investigation by urographic methods should be satisfied that the patient's cardiac and renal condition is equal to the demands that will be made upon it. It is well to recall the advice given in 1941 in "New and Nonofficial Remedies", and set out in "The 1943 Year Book of Radiology", that contrast media are contraindicated for patients with severe liver disorders, nephritis, exudative diathesis (in children) and severe uræmia, and that they should be used with caution in pulmonary tuberculosis, hyperthyroidism and when reduction of blood pressure would be dangerous. It should not be necessary to state that when these media are employed such medicaments as "Coramine" and adrenaline should always be at hand ready for immediate use. Finally, we would urge the Australian and New Zealand Association of Radiologists to arrange among its members for the full recording of all relevant details in any case in which untoward symptoms arise after the injection of contrast media.

### Current Comment.

#### GELATINE IN THE TREATMENT OF SHOCK.

THOUGH the mechanism of shock is still obscure, it is quite clear that the phenomena related to the volume of circulating plasma and to hæmoconcentration give a practical indication for appropriate treatment. It is regarded as rational and indeed essential to try to rectify the diminished plasma volume, and human plasma would appear to be the best fluid to use for the purpose. Even when problems of transport are overcome, for instance by

using dried serum, the question of ultimate supply is not easy. It is not easy for blood banks to keep on delivering large quantities of plasma, for the supply of donors must be continuously reinforced by fresh volunteers. Therefore artificial substitutes have been of considerable interest. It is now interesting to look back and to recall how gum acacia, introduced following the work of the late W. M. Bayliss, was thought to be the ideal colloid for the purpose of restoring plasma volume. Now its unwelcome effects on the respiratory function of red blood cells and its deposition in the liver have caused it to be discarded. Pectin, isinglass and gelatine have all been used and recommended in its place. D. D. Kozoll, H. Popper, F. Steigmann and B. W. Volk have now augmented the animal studies on the use of gelatine with critical trials of this substance in man.<sup>1</sup>

The gelatine used in this investigation was prepared from bone collagen, and in its final state it is in a 5% solution in isotonic saline solution. The viscosity was slightly greater than that of plasma, and the pH was within physiological range. Sterility was ensured by filtration and autoclaving and the addition of a mercurial antiseptic in high dilution. The solution was ascertained to be free of pyrogens. The patients to whom this treatment was given were classed in four categories, according to the clinical degree of shock observed. The cause of the shock was in most cases post-operative, but a few cases of traumatic and hæmorrhagic shock were also included. The mildest cases were those in which the systolic blood pressure had only dropped by not more than 30 millimetres of mercury; in the most severe cases the patients were so shocked that the radial pulse was imperceptible and no blood pressure reading could be obtained. Estimations of hæmoglobin and blood sedimentation rate were made, and the protein content of the plasma was estimated. A quantity of up to 1,000 cubic centimetres of the gelatine solution was given intravenously: it was repeated in two out of 52 cases. No undue reactions were observed. Following the injection the hæmoglobin level and plasma density fell, together with the hæmocrit reading. What is more important, the therapeutic results were gratifying and the clinical state of the patients improved in the majority of cases. The authors conclude that this procedure is safe. The chief drawback so far noticed is concerned with the red blood cells. The sedimentation rate rises after gelatine administration, owing to rouleau formation by the erythrocytes, though Kozoll and his associates have been unable to find any clinical significance in the degree of this change as observed by them. In other respects the results were encouraging, and some of the useful effects of the gelatine were still demonstrable after twenty-four hours.

#### THE TREATMENT OF SCARLET FEVER.

SCARLET FEVER is a disease which, like other epidemic infections, has been subject to change over recent generations. Epidemiological studies have shown that on the whole its virulence has lessened, though every practitioner of experience sees outbreaks in which occasional tragic fatal cases still check complacency. Further, even though we believe that *otitis media* with all its allied dangers and nephritis are more often due to other forms of streptococcal infection, these complications still make us chary of treating scarlet fever too lightly. Modern views have of course corrected the older obsessions concerning a rash, and surely no one now believes that the skin efflorescence of itself is a hall-mark of greater infectivity or of greater toxicity. Nor do we now, as even in the last generation, regard the fragments of desquamating skin as a leprous peril, while overlooking the real significance of the upper air passages as a home for streptococci.

Recent reference has been made in these pages to the period of isolation in scarlet fever, all the more interesting in that it conveyed the views of those qualified by experience to know, general practitioners. But apart from

<sup>1</sup> The American Journal of the Medical Sciences, August, 1944.



epidemiological considerations the disease still needs treatment, and this should be aimed at reducing the dangers of the fortunately rare septicemic form and of the important complications. Max J. Fox and Norvan F. Gordon have published a survey of a series of 7,500 cases in which the results of treatment with convalescent serum have been compared with other methods.<sup>1</sup> Fox has previously published studies on the use of commercial antitoxin and pooled convalescent serum, and in these found that convalescent serum was successful in producing prompt subsidence of symptoms and lower mortality rate. The present work confirms these findings and adds observations on the results of sulphonamide therapy. The sulphonamide drugs have not been found to be effective in controlling the toxic stage of the disease, but were of value in some of the complications. The authors do not mention the danger of silent mastoiditis, especially in young children, a danger that is enhanced by the present tendency to allow a prescription for a sulphonamide drug to replace repeated examination of the ears. In passing it may be observed that the failure of sulphonamides to influence the florid toxic illness associated with such infections as scarlet fever and acute rheumatism may be contrasted with their apparent prophylactic value at least in the latter case. We have a long way to go in understanding the mechanism of these acute toxic states. Fox and Gordon state that antitoxin is of value in combating the toxic phase of scarlet fever, but though they make no very definite statement about it, they consider that some risk of foreign protein reactions is present. Convalescent serum ranks much more highly in their regard, and they class it as the best means of therapy. They find that fever promptly subsides, convalescence begins more quickly, complications are to some extent lessened and the mortality is lowered. They used convalescent serum in 1,000 cases, of which nearly 900 were severely toxic in type, and used as parallel controls another 1,000 cases, of which only 200 were severe. The remainder of the total number of 7,500 cases belong to earlier series. It will be seen that the serum was administered to the more seriously affected patients, and therefore the results are the more striking. Of the serum-treated patients 17 died, and of the controls 20. Septic complications were much more common among the more severely ill patients, as might be expected, and the authors think that sulphonamides used with serum are of value in these. Finally, the dosage is of interest; Fox and Gordon have found that doses smaller than those hitherto employed have been effective, these now ranging from 10 to 20 cubic centimetres in infants for cases of moderate severity to 40 to 80 cubic centimetres in adults severely ill.

#### PNEUMOTHORAX AND ALTITUDE.

THE transport of casualties by air has now become a routine procedure. It is recognized that in cases of respiratory disease consideration must be given to the effect of altitude. Some useful observations have been published by a team of investigators working for a committee of the Canadian National Research Council.<sup>2</sup> The authors of this work, Captain E. W. Peterson, Flight Lieutenant B. J. Kent, Flight Lieutenant H. R. Ripley and Captain K. R. Murphy, have used the decompression chamber to investigate the effect of lowered atmospheric pressure on patients with artificially induced pneumothorax. Arrangements were made so that radiographs of the patients' chests could be taken while they were in the chamber. Records were made of pulse and respiration rates at each 5,000 feet level and a constant estimation of the arterial blood oxygen was made by an oximeter affixed to the ear. Oxygen was administered by a standard "B.L.B." mask so as to ensure that the patients suffered no oxygen lack so far as its supply was concerned, and that therefore any reduction in blood oxygen saturation was solely due to mechanical factors within the chest. The "ascent" in the chamber took place at a rate of 1,000 feet per minute, with plateau levels at 5,000 feet intervals

to allow for X-ray and other data to be collected and recorded. Two patients were investigated. One had only a 20% pneumothorax, the other a 50% pneumothorax; in each case the pneumothorax was well established. It is significant that the man who had only a 20% pneumothorax, although fifty-six years of age, showed little tendency to mediastinal shift, and reached an equivalent height of 20,000 feet before he felt any sensation of fullness in the chest. Moreover, he was still able to oxygenate his blood almost to the full extent even at 20,000 feet, and at 10,000 feet was comfortable without additional oxygen. The patient with a 50% pneumothorax, though with the advantage of youth, for he was only twenty-one years of age, not only felt distress at lower altitudes, but showed reduced blood oxygen values. At 15,000 feet his distress was considerable and even with some allowance for nervousness it was not thought desirable to expose him to the conditions of higher elevation. The physical reason for this is of course evident, but it is strikingly illustrated in tracings of the X-ray records taken at different levels. The homolateral lung was completely collapsed and the mediastinum had moved towards the opposite side. A dry irritable cough was noticed in this patient. The authors suggest that this was due to displacement and kinking of the large air passages, but this is an unconvincing explanation. Surely the cough reflex is more likely to be excited by other causes, possibly vascular in nature. The findings of this experiment are important, and emphasize that even a moderate pneumothorax can easily bring about an uncomfortable and even distressing reduction of pulmonary reserve at higher levels, even if oxygen is given. It is obvious that a tension pneumothorax would cause symptoms even more significant and distressing. Naturally, as the authors remark, no patient with a sucking wound of the chest would be accepted for air transport unless the necessary preliminary treatment had been given to prevent further air suction into the thorax. They also recommend that when a large pneumothorax exists aspiration should be effected before "take-off". In all cases of pneumothorax it is desirable that oxygen be administered continuously from ground level.

The authors do not specially refer to the time factor, but this is one of definite importance. In most of the ambulance flights made with the Australian forces during this war the distances have not been such as to expose patients to prolonged low oxygen concentrations, and when higher elevations have been called for in certain areas these have usually been needed only for short periods. Nevertheless, the indications for special management of patients with thoracic injury in air travel are clearly defined, and the work of Peterson and his collaborators is of value as it places the question on a sound experimental basis.

#### THE RETIREMENT OF DR. E. C. MORLAND.

THE latest mail from England tells of the approaching retirement of Dr. E. C. Morland from the editorship of *The Lancet*. This news is received with mixed feelings. The first thought is one of pleasure that after a long and honourable career in the world of medical journalism, Dr. Morland will be able to rest from the exacting duties of his office and, we trust, enjoy life in pursuits that appeal to him most. The second thought is of the loss to medicine that must occur. Dr. Morland succeeded the late Sir Squire Sprigge as editor of *The Lancet* in 1937; he had been assistant editor from 1915. The place taken by *The Lancet* in the medical life and thought of the English-speaking world is widely recognized and by none more than by the members of the medical profession in Australia. *The Lancet* owes more to Dr. Morland than Australian doctors can possibly realize. Cordial relations have always existed between *The Lancet* and *THE MEDICAL JOURNAL OF AUSTRALIA*, and we recall his warm-hearted message on the occasion of our Silver Jubilee a few years ago. With our greetings to Dr. Morland goes a lively hope that the years to come may be for him "blessed and unweary".

<sup>1</sup> Archives of Internal Medicine, July, 1944.

<sup>2</sup> The Canadian Medical Association Journal, June, 1944.

## Abstracts from Medical Literature.

### GYNÆCOLOGY.

#### Vaginal Hysterectomy.

FREDERICK V. EMMERT (*Surgery, Gynecology and Obstetrics*, September, 1944) reports the technique and the results obtained in 600 cases over a period of fourteen years, during which the operation for vaginal hysterectomy was performed according to the Gillhorn-Emmert modification of the Dickenson technique. After preliminary morphine and hyoscine administration, the parametrium is infiltrated with 0.25% "Novocain" with adrenaline, 3-5 drops to the ounce, on both sides. The cervix is circumcised, the vesico-vaginal and vesico-cervical spaces are opened, and the bladder is pushed off the cervix to the peritoneal reflection. The posterior cul-de-sac is opened, after which the peritoneum overlying the rectum is sutured to the posterior vaginal wall and the left utero-sacral ligament is exposed, ligated and cut. The parametrium is then sutured and cut between successive ties, which are locked together. This is repeated on the left side. Finally the vesico-uterine peritoneal plica is opened, the uterine adnexa are tied and cut and the uterus is removed. The peritoneal cavity is closed by a purse-string suture which places the stumps of the round, Mackenrodt's, broad and utero-sacral ligaments in an intraperitoneal position. The bladder is supported after the anterior vaginal wall has been reflected and redundant tissue is removed by bringing the round ligament to the suprapubic fascia near the upper angle of the wound on either side, the round ligaments thus being interposed between the bladder and the anterior vaginal wall. The bases of Mackenrodt's and of the utero-sacral ligaments are then sutured, and finally a posterior colpo-perineorrhaphy is performed. Follow-up of fourteen years showed satisfactory results in 524 of 600 cases, or 87.33%; in 12% the result was unsatisfactory on account of some local recurrences.

#### Sulphanilamide Absorption via the Rectum and Vagina.

GEORGE L. CARRINGTON, THEA ROHREN, ELSIE JONES AND PHYLLIS MOORE (*Surgery, Gynecology and Obstetrics*, March, 1944) report a short study of the absorption of sulphanilamide when given as a single dose of the dry powder at the completion of operations on the rectum and vagina. For several years the authors had placed 90 grains (5.8 grammes) of sulphanilamide powder in the rectum on completion of operations for hemorrhoids or in the vagina either on completion of operation there or as a preliminary to total hysterectomy, to decrease local infection and so to lessen post-operative pain, inflammation and danger. A check was undertaken recently to estimate the amount of absorption from this site. Seventeen patients with vaginal conditions were taken, seven of the operations being total hysterectomies and eight rectal procedures. The highest concentrations in the blood were obtained in twenty-four hours in the vaginal cases and in six hours in the rectal cases. Variations

in the rate of absorption in the cases studied were regarded as being due either to loss of the drug by expulsion from the rectum or vagina before absorption, or to lack of sufficient moisture in the part to render the drug soluble. Blood concentration after rectal administration was on an average twice as high as after vaginal application. The drug persisted in the blood for a period of from one to six days, the findings being negative in half the cases on the third day.

#### Air Embolism in Criminal Abortion.

DONALD TEARE (*The Lancet*, Volume II, 1944), assistant pathologist to Saint George's Hospital, reports a case of air embolism in criminal abortion which recently came to autopsy at the hospital. Very few such cases have been reported in detail. Most deaths in criminal abortion are due to sepsis and hemorrhage. A few patients, however, die suddenly from air embolism. At the third or fourth month of pregnancy the uterine vessels are so narrow as to be incapable of carrying a sufficiently large quantity of air to the heart to cause death. Recently, however, the ordinary enema syringe is coming into more common use as an instrument of abortion, fluid being injected into the pregnant uterus. One squeeze of an ordinary enema syringe will force 43 cubic centimetres of water into the uterus at high pressure, and 25 cubic centimetres of air have been found in this if soapy frothy water is used. In the case reported the patient was six months pregnant. An enema syringe was used with soapy water. The patient immediately turned blue, collapsed and died in less than fifteen minutes. At autopsy the membranes were found stripped from the uterine wall up to a point an inch above the lower attachment of the placenta. In the cavity was found a quantity of froth and fluid in immediate contact with the uterine wall and placental site. The blood in the upper part of the inferior vena cava, the right side of the heart and the pulmonary artery was found to be pink and filled with bubbles. The bubbles could be traced into the smaller branches of the pulmonary arteries, and the lungs were partially collapsed. The fetal membranes were not ruptured. The bubbles had the typical shining surface of soap bubbles and the rainbow effect of saponin could be clearly seen. This excluded the possibility of decomposition as the source of the bubbles and demonstrated the path taken by the bubbles from the uterine vessels to the pulmonary arteries.

#### Sterility.

ALBERT SHARMAN (*The Journal of Obstetrics and Gynecology of the British Empire*, April, 1944) reports the results of certain aspects of the examination in 500 cases of primary sterility. In the estimation of tubal patency by insufflation the author stresses the value of the kymograph. Finding that tubal spasm often gave a fallacious result of non-patency, the author used this instrument in a series of cases to demonstrate the effect of alteration in the rate of flow of gas during anesthesia and variation of the menstrual phase at which the test was performed. He concluded that none of these factors had any constant bearing on the result of insufflation tests. An important fact, however, is that one

negative result of the test is not to be considered conclusive evidence of non-patency, as tubal spasm may be present. Also the procedure may have a therapeutic effect in overcoming minor degrees of tubal blockage and subsequent tests give a more satisfactory result. The author concludes that the results of lipiodol injection are more accurate than insufflation when only one test is performed. Furthermore, it enable the site of blockage to be located in cases of non-patency of the tubes. With regard to endometrial biopsy, the author insists that the test must be made in the premenstrual phase. The presence of secretory endometrium at this phase is reliable evidence of corpus luteum formation and presumptive evidence of ovulation. Although in only a small number of cases in the series were anovulatory cycles discovered, these patients never became pregnant, and therefore this factor is one of major infertility. Another finding was the high incidence of endometrial tuberculosis in unsuspected cases (5% in a series of 880 cases of sterility). In some cases tuberculous change was evident in one biopsy specimen, whereas another one from the same patient showing only chronic endometritis was found. The author states therefore that chronic endometritis in a case of primary sterility should be regarded as suspicious of tuberculous infection. When present it seems to prevent pregnancy permanently. The fact that in 77% of these patients tubal blockage was present, led the author to conclude that unsuspected subclinical salpingitis might be more common than usually supposed as a cause of tubal occlusion. He produces figures to show that, except in cases of gross tubal lesions, which are fairly rare, gonococcal salpingitis is not an important factor in producing occlusion of the tubes. Also he regards congenital hypoplasia as an unimportant factor, and produces evidence to show that the hypoplastic tube is not essentially a non-patent structure. The importance of examining the seminal fluid of the husband before the wife is submitted to operative procedures is stressed. In a follow-up of this series it was found that 28.3% of the patients subsequently became pregnant. An analysis is made of the findings in these women. Among the unsuccessful cases, major infertility factors were anovular menstruation, endometrial tuberculosis, tubal blockage and azoospermia.

### OBSTETRICS.

#### Coexisting Intrauterine and Extra-uterine Pregnancies.

S. J. KING (*The New England Journal of Medicine*, December 23, 1943) reviews the subject of coexisting intrauterine and extrauterine pregnancies and reports a case in which the intrauterine pregnancy was normal and resulted in the simple pelvic delivery of a living female infant. The author states that coexisting intrauterine and extrauterine pregnancies may be divided into two groups—combined or simultaneous and compound. In the compound type the intrauterine pregnancy becomes superimposed on an already existing extrauterine implantation, which may have been present for a variable time, even as long as several years. As a rule



this type of extrauterine pregnancy is quiescent and does not produce symptoms, but may be detected by physical examination. In combined intrauterine and extrauterine pregnancies, on the other hand, the situation is different. The combination is probably identical with a multiple pregnancy, except that while one or more of the fertilized ova reach the intrauterine spaces, where they commence normal development, the remaining ovum or ova become simultaneously implanted outside the uterus, in the Fallopian tubes or in the ovary or at some site within the abdominal cavity. In these circumstances the extrauterine pregnancy may produce typical symptoms and signs of an early ectopic pregnancy at four to twelve weeks, usually at about eight weeks, when internal hemorrhage or tubal rupture occurs, and prompt surgical relief becomes necessary. On the other hand, the extrauterine pregnancy may fail to cause the classical syndrome of the early weeks, and may even proceed to term or near term and even be productive of a viable, not necessarily normal, infant. The intrauterine pregnancy is no different from any other gestation; abortion or miscarriage may occur, with or without apparent cause, or it may proceed to term and result in a normal living infant. The author stresses the need for correct treatment at the right time, in order to save the life of the mother and possibly that of the intrauterine fetus as well. The second half of pregnancy is the dangerous period. Operation during the late stage, although advised, involves certain technical considerations. Walling off, as in Caesarean section, is necessary to minimize the escape of amniotic fluid if possible, because the fluid is an active peritoneal irritant. If the placenta is implanted on the broad ligament, it may be removed, and possibly hemostasis may be effected without complications. However, if the implantation is on the aorta, the liver or parts of the gastro-intestinal tract, it is best to cut the cord close to the placenta, leaving the secundines intact to resolve; this they do promptly in the absence of infection. Whether drainage shall be instituted requires decision in each case. If the fetus is dead, the secundines can easily be removed from any site.

#### Continuous Caudal Analgesia and Anaesthesia and Blood Loss in the Third Stage of Labour.

N. W. VAUX AND R. M. MITCHELL (*The Journal of the American Medical Association*, February 26, 1944) have made a study of the effect of continuous caudal analgesia and anaesthesia on the blood loss during the third stage of labour. Their clinical material consisted of 1,000 obstetric patients given inhalation anaesthesia and 1,000 obstetric patients given continuous caudal analgesia and anaesthesia. The determinations of blood loss were made by measuring the amount lost from the termination of the second stage of labour up to and including the first hour after delivery. The authors find that since the adoption of continuous caudal analgesia and anaesthesia the amount of blood lost has been decidedly decreased. None of their patients given this form of anaesthesia lost 501 cubic centimetres of blood or more, whereas 28 patients given inhalation anaesthesia did lose this amount or more. Of the

patients delivered under continuous caudal analgesia, 97.4% lost 0 to 250 cubic centimetres of blood, whereas only 79.1% of those delivered under inhalation anaesthesia lost no more than this amount. Continuous caudal analgesia shortens the third stage of labour; in the series there were only two cases in which the third stage lasted more than thirty-one minutes, whereas there were seventeen cases in the inhalation anaesthesia series. The incidence of "trapped" placenta in the 1,000 caudal anaesthesia cases was 0.1%. In the inhalation anaesthesia series manual removal of the secundines was required in six instances. Uterine myometrial hemorrhage on incision at the time of Caesarean section is decidedly diminished if continuous caudal anaesthesia is used. The authors believe that continuous caudal analgesia and anaesthesia in obstetrics enable the uterus to approach its normal mechanism more closely.

#### Continuous Caudal Analgesia.

ROBERT A. HINGSON (*The American Journal of Obstetrics and Gynecology*, May, 1944) issues a warning of the dangers attached to indiscriminate use of caudal anaesthesia by untrained obstetricians. He believes that continuous caudal analgesia, when properly induced, will completely relieve the pains of labour and delivery. Nevertheless the limitations of the technique are important. It is not a procedure to be used in the home or in the poorly staffed hospital. This fact, together with the contraindications for individual patients, would mean that only 12% of American women would be able to benefit from this form of pain relief. Continuous caudal analgesia should not be used in cases of short easy labour, nor is it suitable for the apprehensive type of patient. Extreme obesity, spinal disease or deformity and local infection at the site of injection are further contraindications. Obstetric complications preventing its use are placenta praevia, premature separation of the placenta, disproportion and the birth of monstrous and predetermined dead babies. The physicians using the technique should have a period of special training. The patient should be surrounded with safeguards of readily available oxygen vasopressors and all others means of dealing with an emergency. Diligent attention should be given to the Bishop X-ray technique of minute study of the sacrum. Finally it should be emphasized that continuous caudal analgesia is designed to relieve the pains and not the early discomforts of labour. The best results are obtained when it is employed for less than five hours per patient.

#### The Prognosis and Management of Premature Rupture of the Membranes.

EDWARD H. BISHOP (*The American Journal of Obstetrics and Gynecology*, July, 1944) gives a statistical survey of 639 cases of premature rupture of the membranes. He concludes that this condition in no way contributes to dystocia or to any increase in foetal or maternal morbidity. On the contrary his figures show a duration of labour somewhat shorter than the average. This tends to invalidate the popular belief that the bag of waters is necessary for efficient dilatation of the cervix. When the membranes rupture before

the onset of labour they probably do so only when the presenting part is able to descend far enough to exert pressure upon the forewaters. This series shows no increase in morbidity of the mother because of rupture of the membranes prematurely, nor does the morbidity rate increase with the lengthening of the latent period before labour ensues. The main features of the management in these cases is to maintain reasonable aseptic precautions. This may involve hospitalization. If the patient is near term a medical induction of labour may be attempted, but generally speaking it is best to wait for the spontaneous onset of labour.

#### Cord Transfusions in Newborn Infants.

HARRY W. MAYES (*The American Journal of Obstetrics and Gynecology*, July, 1944) describes a simple technique for transfusion of newborn babies through the umbilical vein. He recommends that a needle or cannula be inserted into the vein before the cord is tied and that the cord should be clamped at the placental end when the blood begins to flow. The needle should be inserted as far from the baby as possible. The author quotes successful results with this technique in the transfusion of premature babies, when the need for nourishment and respiratory stimulation in the first few hours after birth is urgent. In hemorrhage or tendency to hemorrhage, and if erythroblastosis is suspected, the benefits of such early transfusion are, of course, obvious. Also, in mature or full-term infants suffering from shock or difficult delivery it is of great prophylactic value.

#### The Elderly Primipara.

KATHERINE KUDE AND DONALD JOHNSON (*The American Journal of Obstetrics and Gynecology*, June, 1944) analyse a series of 830 patients who, at the age of thirty-five years or more, were delivered of their first viable child. They conclude that a normal individual who marries late in life and is delivered of her first child at an age of thirty-five years or more is less liable to complications than one who has a history of a long period of infertility before confinement. The two most frequent complications found were toxemia and myoma uteri. Both of these had a higher incidence in the elderly primipara group. Contracted pelvis was more common in this group, and especially that associated with the funnel-shaped pelvis. Careful X-ray study of the pelvis and estimation of disproportion are therefore advisable. The expected date of delivery must be ascertained, for it was seen that in the elderly primipara who goes more than two weeks past term, the labour is longer and the infant mortality higher. In these post-mature cases operative interference should be favoured, especially if any complication is present. The foetal and maternal mortality and morbidity were found to be higher among the whole group of elderly primiparae, as well as the necessity for operative delivery. It is pointed out that in the selection of the type of delivery for this group of patients, the greater importance of the fetus must play a role. This is especially true when the patient gives a long history of relative sterility or of repeated spontaneous abortion.



## British Medical Association News.

### SCIENTIFIC.

A MEETING of the Queensland Branch of the British Medical Association was held on July 7, 1944, at the Mater Misericordiae Public Hospital, South Brisbane. The meeting took the form of a series of clinical demonstrations by members of the staffs of the Mater Misericordiae Public Hospital and the Mater Misericordiae Children's Hospital. Part of this report was published in the issue of November 4, 1944.

#### The Development and Treatment of the Vicious Circle following Gastric Operations.

Dr. H. J. WINDSOR directed his remarks on post-operative complications in gastric surgery to the development and treatment of the so-called vicious circle arising after major gastric operations. Cinematograph slides were shown illustrating the normal emptying of the remnant of stomach after various methods and degrees of partial gastrectomy, and in three instances the complete stenosis at the stoma when the vicious circle supervened. It was pointed out that in the latter instance bile could enter the stomach owing to the peristalsis in the proximal limb of the anastomosis, which overcame the block at the stoma, whilst the atonic state of the remnant of stomach prevented its being effective in emptying itself through the more or less blocked stoma into the distal limb of the anastomosis.

Dr. Windsor showed slides to illustrate the fact that when the block was complete, barium introduced into the stomach did not enter either limb of the anastomosis. As the condition was relieved, a trickle of barium appeared in one or other limb of the anastomosis, and when the stenosis was reduced the barium was discharged freely into the distal limb. The block was clearly at the stoma and could have been caused by oedema and swelling at this site, which, as they subsided, eventually allowed normal drainage of the stomach to take place. That another factor might be operative in the development of this condition was illustrated by slides of the condition arising in a patient who had fifteen years previously undergone gastro-enterostomy for duodenal ulcer, and who developed symptoms attributable to "adhesions". At a second operation adhesions were liberated, particularly in the region of the anastomosis. In this case a most persistent vicious circle developed. These slides revealed a condition practically identical with the vicious circle arising in a recently formed anastomosis following the same course and subsiding in the same way. Dr. Windsor said that it was possible that the unusual amount of manipulation to which this anastomosis was subjected caused sufficient trauma to produce swelling and blocking at the stoma, for radiologically no other factor could be detected. Some misalignment of the limbs of the anastomosis or retraction of the anastomosis within the opening in the mesocolon *et cetera* could theoretically account for this development; but if so, it corrected itself automatically under the usual methods of treatment.

Dr. Windsor went on to say that the development of the vicious circle was early evident if an accurate record was made of the amount of all fluids taken orally and the amount removed by suction through the tube inserted into the stomach. By the third post-operative day (when in practically all cases liver function, which was often in abeyance for a few days, had been reestablished) the development of this condition might be suspected. If it had developed, the amount of fluid removed by suction in twenty-four hours would equal the amount given by mouth together with an amount equal to the daily output of bile and an indefinite amount of fluid exuded at the oedematous stoma. In practice, however, the stoma might be regarded as blocked if suction withdrew a quantity equal to the amount taken orally together with thirty ounces, representing under post-operative conditions twenty-four hours' secretion of bile. Any less amount withdrawn would suggest incomplete stenosis; but if the amount continued at that rate or greater, a small barium meal might be given and the condition of the stoma determined. By exercising intermittent suction—to allow the stomach contents to drain into the bowel, but not to be retained unduly in the stomach—it would soon be apparent from the daily balance sheet of fluids taken and rejected to what extent the stoma was functioning. If the block was incomplete, resolution would occur in a few days. Should the block be complete, operative treatment should be undertaken by the fifth post-operative day, and certainly not later than the seventh day, for the

patient's condition was apt to deteriorate rapidly after that time in spite of any other form of therapy.

Dr. Windsor said that various operative procedures had been suggested to deal with the condition. Occasional success had been obtained by some rearrangement of the anastomosis to correct distortion of the limbs, or by short-circuiting the anastomosis by performing entero-anastomosis between the limbs. It was, of course, desirable to inspect the anastomosis in case gross peritoneal infection had occurred and required treatment on general principles. Except for the latter precaution, Dr. Windsor thought that no purpose was served by interference with the anastomosis, and operation should be confined to the provision of safe enterostomy through which the patient might be fed. The establishment of a valvular enterostomy was therefore undertaken. A loop of jejunum about eight inches long was picked up about fifteen inches below the stoma, and entero-anastomosis between the limbs of this loop was performed. This short-circuited this loop, into the distal limb of which a catheter was fixed after the manner of Witzel's gastrostomy. The catheter should extend into the distal part of the jejunum several inches beyond the entero-anastomosis. The bowel was returned to the abdomen, and the catheter was brought to the exterior through a stab wound at a distance from the incision. The patient could then be fed with large amounts of nourishing fluids and semi-solids, as well as with the bile removed from the stomach by suction. With this arrangement he could carry on safely and in moderate comfort until the stoma functioned. The return of function might require seven to ten or even fourteen days, as in the instance quoted, in which gastro-enterostomy had been performed years previously. Dr. Windsor said that the operation could readily be performed under local anaesthesia with a minimum of shock to the patient; it converted a condition of grave danger into one at the worst of extreme inconvenience. Feeding through the enterostomy might require detailed supervision. It might be continuous; but if the amount given exceeded six pints in twenty-four hours there was apt to be some regurgitation through the entero-anastomosis and eventually through the stoma by antiperistalsis, when the material would be recovered through the stomach tube. However, intelligent anticipation would prevent this development. Should the regurgitation persist, it was likely that some other factor was operative, the most usual being threatened uraemia. However, this should not develop unawares, as daily estimates of the blood urea content were helpful in determining the onset of renal failure. Apart from such a development, the further history of a patient so treated should be uneventful. The balance sheet of fluids given by mouth and recovered by suction should indicate gradual improvement of the stoma, and this could be confirmed by another X-ray examination. When improvement was complete, enterostomy feeding was discontinued and recovery would be progressive.

Dr. Windsor said that, as he had pointed out, the operation of establishing an enterostomy was accompanied by entero-anastomosis between the limbs of the chosen loops. Without this the enterostomy could be, and would almost certainly be, a potential site of obstruction if it was of a valvular nature. With the entero-anastomosis the enterostomy was short-circuited, and no obstruction was experienced. Owing to the valvular nature of the enterostomy, no fluid escaped from it when the catheter was withdrawn, and no operative interference was required for its closure. Fortunately, persistent vicious circle was an uncommon experience; but it did occur, and a simple method of dealing with it, such as that described, would greatly enhance the patient's prospects of recovery.

During subsequent discussion Dr. Windsor emphasized that in all types of gastric resection there was a great deal of trauma and injury to peritoneal surfaces, which should be minimized as far as was surgically possible to ensure smooth recovery for the patient and to avoid complications from adhesions *et cetera*. In any case, the inevitable trauma could be compensated quickly by a simple post-operative procedure. The procedure was post-operative to the extent that it was performed after the operation was complete, but before the abdomen was closed. It consisted in the installation directly into the bowel of forty ounces of peptonized milk saturated with glucose, to which two ounces of brandy were added. The brandy caused dilatation of the blood vessels of the bowel and promoted speedy absorption of the milk, which could sometimes be visualized during the procedure by the development of distended lacteals streaming away from the bowel into the mesentery. This probably provided an immediate supply of lymph to all lacerated areas, which were sealed off in the matter of a few hours. There was no doubt about the beneficial action of the pro-

cedure, for patients so treated exhibited a minimal peritoneal reaction. Post-operative pain was minimized, distension did not occur, thirst was obviated, and in four or five days an action of the bowels might occur spontaneously. Dr. Windsor said that he had come to regard this method as the almost perfect means of safeguarding the peritoneum and superior to all other post-operative procedures. Its value was enhanced by operation under local anaesthesia, which ensured gentle handling of viscera and a freedom from the usual post-operative effects of general anaesthesia. This form of post-operative treatment could be extended to any intraabdominal procedure, and could be effected by a variety of means. It was, however, simply and quickly effected by a catheter inserted through a stab opening into the bowel some distance below the stoma, whilst the fluids were prevented from regurgitating through the stoma by the temporary application of a bowel clamp. This procedure enabled nature speedily to make secure the work of the surgeon, and it should be of inestimable value, particularly at the present time, in assisting to combat infection after traumatic injuries of the abdominal viscera.

#### VICTORIAN BRANCH NEWS.

A MEETING of the obstetric staff of the Queen Victoria Hospital, Melbourne, to which all members of the Victorian Branch are invited, will be held at the hospital on Wednesday, November 22, 1944, at 8.15 p.m. The subject of the meeting will be "Tuberculosis and Pregnancy"; the speakers will be Dr. Clive Fitts, Dr. H. Maxwell James, Dr. Hilary Roche and Dr. Isabel Ireland.

#### NOTICE.

ANY member of the Association intending to apply for the position of fourth medical officer to the Yallourn Medical and Hospital Society is requested to communicate with the Medical Secretary of the Victorian Branch of the British Medical Association before submitting his application.

### National Emergency Measures.

#### SUPPLIES OF RICE.

IN the issue of November 4, 1944, a letter from the Secretary of the Department of Agriculture (Marketing Division) on the subject of supplies of rice was published at the request of the General Secretary of the British Medical Association in Australia. A further letter has been received from the department as follows:

[COPY.]

COMMONWEALTH OF AUSTRALIA.  
Department of Commerce and Agriculture.

A.M.P. Chambers,  
419, Collins Street,  
Melbourne, C.I.,  
31st October, 1944.

Dear Sir,

With reference to my letter of 17th October concerning the supply of rice to civilians upon production of a medical certificate, I desire to advise you that this matter has been given further consideration, and in view of the small quantity of rice involved it has been decided to continue for the present the issue of rice in cases where a medical certificate is furnished.

I should be glad if you would kindly arrange for your members to be advised.

Yours faithfully,

(Signed) J. F. MURPHY,  
Secretary.

Dr. J. G. Hunter,  
General Federal Secretary,  
British Medical Association,  
135, Macquarie Street,  
Sydney, N.S.W.

### Correspondence.

#### HOSPITAL ACCOMMODATION.

SIR: The Federal Government has offered the sum of six shillings per day per patient to hospitals in Australia. Unfortunately there are not hospital beds available to put the patients in. The practitioners of medicine know this only too well. The people of Australia are suffering hardship, and mortality is increasing, because of the shortage of hospital beds for those who need them. Owing to lack of staff many private hospitals have closed their doors in the last three or four years. No new hospitals have been built, and the consequence is that those who could afford private hospitals must go into public hospital beds in many cases, and thus exclude those who cannot afford to pay.

If this federal subsidy is spent as a bed subsidy, there will be no money available to build hospitals, and many Australian people will die for lack of hospital accommodation for many years to come. This is no exaggeration. For the sake of humanity, when the Federal Government has the money available, why is it not spent on what is urgently needed? The Federal Government could make the money available to the States for the purpose of building or extending hospitals. We are already fifty years behind the times in hospital accommodation, and this is an age when the best treatment can be obtained only in hospitals for many complaints. Although the Government probably does not intend it so, the result of this bed subsidy, if persisted in, will be to prevent many of the sick poor from obtaining necessary hospital treatment.

The Federal Government could now, when money is available, make themselves many lasting monuments throughout Australia, by building hospitals or providing the money to do so. If they persist in not using available money for that purpose, they will be condemning Australia to hopelessly backward hospital accommodation for fifty years. There is no inexhaustible supply of money, and when the war ends there will be no money available to build hospitals. If this opportunity is lost, pity the people of Australia and the unfortunate doctors and nurses, who will have to work with obsolete methods for another generation or more.

Yours, etc.,

G. C. WILLCOCKS.

143, Macquarie Street,  
Sydney,  
October 18, 1944.

#### SOME CONTRASTS BETWEEN ARMY MEDICINE AND PRIVATE PRACTICE.

SIR: It is laid down in military orders that it is the duty of regimental medical officers to keep men on duty with the unit unless they are suffering from a disability which will endanger health or prevent them from performing that duty; and these few lines mark one important contrast with normal private practice. The army's goal is health expressed in terms of fitness for work. The regimental medical officer is instructed and encouraged to minimize his patient's troubles whenever it is reasonably safe to do so. He is given the impression that he has behind him a strong organization that will back him in his inevitable mistakes provided they are not disastrous or disgraceful; and so he is nerved to the difficult but necessary army duty of ordering his patient back to work. How different all this is from private practice where the doctor is little concerned about loss of working time and rather regards it as more important to see that work does not start too soon. Every doctor soon learns to say from his heart: "We cannot take risks where health is concerned." The fear of a spreading rumour that he is unsympathetic is ever before him. Also the ruinous result of an action for neglect. It is safer to over-treat (even unto death) with powerful modern drugs, than to over-reassure a patient. It is more profitable to make ten neurotics by over-examination, over-treatment and over-restraint than to tell one *malade imaginaire* (or lazy skulker posing as such) that he can and should work. If Dr. A and Dr. B, of equal authority, make announcements in the same issue of the journal, Dr. A that some established custom is unnecessary, and Dr. B that something previously regarded as inconsequential is potentially dangerous, who gets the better hearing?

Once a doctor has learned, as all good doctors do, that we cannot take risks where health is concerned—a statement perfectly true in a restricted sense—it is easy to expand it

to: "Only the best is good enough. It is foolish to count the cost of medical treatment." Now this is rank lunacy, for as regards minor ailments and some of the major, we know that they are more influenced both in onset and departure by the patient's general conditions of living—his food and drink, his clothing, his manner and place of work, his recreation and sleep—than by any treatment given by a civilian practitioner, yet an attitude of "damn the expense" is not encouraged in these matters. So carefully has this false idea been fostered in medicine that even people who live on badly prepared food in substandard houses resent being treated with cheap drugs. To the army patient all the drugs he gets are cheap, and he takes what is given to him. It is the duty of his medical attendant to see that he gets what is necessary. Powerful remedies are used only under proper controls. Centralized medical records and the treatment of serious cases by a succession of doctors allow a quick impartial evaluation of new methods, new information is rapidly spread, and the results are good. But the treatment of established disease or injury is only a small part of a regimental medical officer's duty. A larger part is to make recommendations on any matter which will increase the fitness of the forces or diminish non-battle casualties. For this part of his work to be successful it is essential that there shall be no free choice of medical attendants. A unit must be treated as a whole, which does not mean that all its members must be treated alike. A soldier cannot stick to a doctor who understands his constitution, but any medical officer is presumed capable of learning to understand it. I have noticed that in base areas where patent and proprietary remedies are available to the troops, they do not appear to be as much used as among civilians, so I deduce that the members regard their relationship with their medical officers as satisfactory.

Yours, etc.,

J. Hogg,  
Major, Australian Army  
Medical Corps.

October 19, 1944.

#### THE MEN IN THE SERVICES AND THE FUTURE.

SIR: Stimulated by your recent leading article of October 28, 1944, I write this note in the hope that it may prove of some value.

They are perilous times which make necessary close and even militant cooperation of members of our profession to our common end, but assuredly that need exists. Barely did we require the statement of the Treasurer to the Federal Council to convince us of our need, but if anything were wanting, the Government, in its Ministers' latest announcements, has supplied it.

Not only do these "bound apprentices" of subsidized students loom as a shadow on the future—there is a far larger pool of graduates who may be a graver peril to the maintenance of those ethical standards our council is demanding. I refer, of course, to the men in the services, men bound by their oath of enlistment to do what their government demands of them until released from its service.

Recently home from one of the forward areas, I was there stationed within contact distance of perhaps one hundred medical officers of the three services. We met often, and we discussed our future with vigour. Believe me, sir, the average man in the field is considerably exercised as to what that future will be.

Many, the older men, are not sanguine. The majority, the younger men, are frankly unable to form concrete opinions on what will be best for themselves. Having no experience of what practice was before the war, the younger men are in the main disposed to accept as inevitable and regard with complacency the easy way back to civil life offered by a controlled medical service. Their one definite and universal distrust is for a continuance of regimentation, which they know such a service would involve.

I have observed some interesting features. The most striking is that the man in the services does not know what is being done by the Association in combating the threats of socialization. It seemed that men from New South Wales alone received their journals. There were represented all States in this area, and the New South Wales people fairly consistently had their journals, but not so men from any of the other States.

To instance the prevailing lack of knowledge, at a discussion between some twenty men, none knew of the Federal Council's attitude to the *Pharmaceutical Benefits Act*, nor of Sir Henry Newland's firm statement in refuting sections of the act. Few are aware of any of the practical pro-

posals made by the Planning Committees for alternative systems of medical practice.

It follows almost automatically that where not enough is known, adverse criticism has been common.

To produce some constructive suggestions, humbly sir, I think that all graduates of our faculty are anxious to do what is best for the whole, and if given a lead, will eagerly follow any firm policy which promises a safe future. You know and I know that the Association has been most assiduous in exploring all the possibilities and has in fact given a clear statement of its intentions and wishes in the matter; but the men in the field do not know it.

The council, with benefit to all, might inform this important section of the profession all that it has so well done. The work and trouble so involved would be more than compensated in the effects produced. It would necessitate a direct address to each man—publication in the journal will not reach them.

Unity in thought and action is so vastly necessary that you will see in this letter simply an expression of the opinion of one who eagerly desires it.

Yours, etc.,

154, Hopetoun Avenue,  
Vaucluse,  
November 6, 1944.

C. M. BURNS.

#### PERCUTANEOUS ADMINISTRATION OF VITAMIN K AS PROPHYLAXIS FOR HÆMORRHAGE OF THE NEWBORN.

SIR: In THE MEDICAL JOURNAL OF AUSTRALIA of November 8, 1941, we brought forth evidence that vitamin K applied percutaneously to patients with obstructive jaundice had a marked effect in restoring the blood prothrombin to its normal level.

Since our original investigation, further cases have been treated with similar success. At the time we suggested that this form of therapy should be administered either to the newborn infant or to the mother at the beginning of labour. This procedure we thought would reduce the incidence of hæmorrhage in the newborn. These views have subsequently been supported by other groups of workers, namely, H. K. Russell, R. C. Page,<sup>(1)</sup> Vollmer, Abler and Altmann.<sup>(2)</sup> From the practical standpoint we note that F. Arden<sup>(3)</sup> considers that hæmorrhagic diseases of infants are not uncommon in this country. In his experience one case occurs in approximately every 390 births.

More recently Lehmann<sup>(4)</sup> has recorded his observations on 13,000 infants; working in the Sahlgrenska in Sweden, this author administered by mouth, water soluble vitamin K derivative, and concluded that by this means 1.6 per thousand infants could be saved. Observations of animals maintained in tropical zones show that such animals are more prone to manifestations of vitamin K deficiency than are those in temperate zones, and the same probably applies to man.<sup>(5)</sup>

The above facts are quoted in order to emphasize our original suggestion that vitamin K in oily solution should be administered by inunction as a routine prophylactic measure.

Yours, etc.,

A. B. CORKILL.  
P. FANTIL.

The Baker Institute,  
The Alfred Hospital,  
Melbourne.  
October 24, 1944.

#### References.

- (1) *The American Journal of the Medical Sciences*, Volume CCII, 1941, page 355.
- (2) *American Journal of Diseases of Children*, Volume LXIV, 1942, page 462.
- (3) *THE MEDICAL JOURNAL OF AUSTRALIA*, Volume II, 1941, page 343.
- (4) *The Lancet*, April 15, 1944, page 493.
- (5) *American Journal of Physiology*, Volume CXLI, 1944, page 359.

#### Naval, Military and Air Force.

#### APPOINTMENTS.

THE undermentioned appointments, changes *et cetera* have been promulgated in the *Commonwealth of Australia Gazette*, Number 223, of November 9, 1944.



NAVAL FORCES OF THE COMMONWEALTH.

*Permanent Naval Forces of the Commonwealth (Sea-Going Forces).*

**Promotion.**—Surgeon Lieutenant (D) Allen Walton Hexter is promoted to the rank of Surgeon Lieutenant-Commander (D), dated 1st November, 1944.

**Termination of Appointment.**—The appointment of Ronald Arthur Perkins as Temporary Surgeon Lieutenant (D) is terminated, dated 10th September, 1944.

*Royal Australian Naval Reserve.*

**Promotion.**—Acting Surgeon Lieutenant-Commander Sidney Arnold Sewell is promoted to the rank of Surgeon Lieutenant-Commander, dated 1st October, 1944.

**Promotion.**—Surgeon Lieutenant Nicholas Larkins is promoted to the rank of Acting Surgeon Lieutenant-Commander, dated 30th September, 1944.

ROYAL AUSTRALIAN AIR FORCE.

*Permanent Air Force: Medical Branch.*

Temporary Wing Commander E. C. Heffernan (1186) is granted the acting rank of Group Captain whilst occupying a Group Captain post with effect from 1st August, 1944.

*Citizen Air Force: Medical Branch.*

The probationary appointment of Flight Lieutenant A. J. Tonakie (277429) is terminated with effect from 1st September, 1944.

William Joseph Barrett (267742) is appointed to a commission on probation with the rank of Flight Lieutenant with effect from 6th August, 1944.

Adrian Mackay Johnson (267741) is appointed to a commission on probation with the rank of Squadron Leader for part-time duty with effect from 1st August, 1944.

The probationary appointment of Flight Lieutenant G. W. Browne (267689) is confirmed, with effect from 13th September, 1944.

The probationary appointment of Pilot Officer (Acting Flight Lieutenant) M. E. Griffiths (423105) is confirmed, and he is promoted to the rank of Flying Officer, with effect from 25th September, 1944.

The following Temporary Flight Lieutenants are granted the acting rank of Squadron Leader whilst occupying Squadron Leader posts with effect from the dates indicated: W. A. McKay (253472), 16th August, 1944, E. L. Davey (251236), 1st September, 1944.

*Reserve: Medical Branch.*

The following officers are transferred from the Active List with effect from the dates indicated: Wing Commander A. S. DeB. Cocks (281255) (on Part-Time List), 1st October, 1944, Squadron Leader G. Simpson (252083), 16th September, 1944.—(Ex. Min. No. 278.—Approved 8th November, 1944.)

The following are appointed to commissions on probation with the rank of Flight Lieutenant with effect from the dates indicated: Alan Montgomery Beech (257693), Alan Stuart Feddersen (257692), Edward Leo Ryan (257691), Leslie Critchley Dunlop (267739), Peter Matheson Birrell (297470), 1st July, 1944, George Shaw (257689), Andrew Colgate Newell (257690), 6th July, 1944, Percy James White (257696), John Vincent Vaughan (257698), John Leys Fordyce (257695), 26th July, 1944.—(Ex. Min. No. 285.—Approved 8th November, 1944.)

The following officers are transferred from the Active List with effect from the dates indicated: Temporary Wing Commander S. G. Preston (251194), 23rd September, 1944, Temporary Squadron Leader J. C. A. Dent (261602), 20th September, 1944, (Temporary Flight Lieutenants) G. F. Blaxland (268523), 20th September, 1944, J. G. Shelton (255945), 22nd September, 1944.—(Ex. Min. No. 289.—Approved 8th November, 1944.)

CASUALTIES.

ACCORDING to the casualty list received on November 7, 1944, Colonel H. H. Jamieson, A.A.M.C., North Sydney, has been removed from the "seriously ill" list.

According to the casualty list received on November 7, 1944, Major R. H. Formby, A.A.M.C., College Park, South Australia, who was previously reported to have been placed on the "dangerously ill" list, is now reported to have died of illness.

Obituary.

PHILIP THORNTON THANE.

DR. PHILIP THORNTON THANE, whose death was recently recorded in these pages, was born at Bloomsbury, London, on April 24, 1859. He was the fourth son of the late George Dancer Thane, M.D., who practised in Bloomsbury and later at Russell Square. His eldest brother was George Dancer Thane, who was for forty-two years professor of anatomy at University College, London, being succeeded in that position by the late Grafton Elliot Smith. A younger brother was the late Edgar Herbert Thane, M.D., who practised at Gordon near Sydney and died in 1930.

Philip Thornton Thane was a pupil at University College School, Gower Street, London, where he gained many prizes in Latin, mathematics, English history, the English language and so on. In October, 1877, he entered Middlesex Hospital Medical School, where he gained prizes in anatomy, physiology, chemistry, pathology and midwifery. In 1880 he gained the Governors' Prize. This prize was won in the following year by the late John Bland-Sutton. In 1880 Thane also gained the first Broderip Scholarship; Bland-Sutton secured this honour also in the following year. In 1881 Thane was admitted as a member of the Royal College of Surgeons of England and a Licentiate of the Society of Apothecaries. In September, 1881, he sailed for Australia on the ship *Parramatta*, returning to England by way of Cape Horn after a four months' voyage. In July, 1882, he was admitted Licentiate of the Royal College of Physicians of London. In the following October he sailed for Australia in the ship *Yarra Yarra* and arrived in Sydney in January, 1883. He was almost at once appointed medical officer of the Walgett Hospital, New South Wales, but in 1884 he moved to Yass, where he joined the late Allan Campbell as partner. He practised in Yass for many years and served the community in many ways apart from his work as a doctor—as coroner, member of the Licensing Bench, magistrate, alderman, mayor, church warden of Saint Clement's Church and in other organizations. When he left Yass in 1913, the townsfolk presented him with a handsome piece of plate. He took charge of the practice of the late James Adam Dick when he served abroad in the war of 1914-1918 and then resided at Double Bay. In 1922 he suffered from a severe attack of *encephalitis lethargica*, after which he retired from active medical work. He married twice—in 1883 and in 1895. His second wife, daughter of the late Dr. James Guinness Beatty, of Liverpool, England, survives him.

Philip Thornton Thane contributed from time to time to *The Australasian Medical Gazette*. His papers between 1886 and 1912 total ten. One of these, on the treatment of hydatid cysts, was a retiring president's address to the Central Southern Medical Association. At the Intercolonial Medical Congress, held at Sydney in 1892, he read a paper on the treatment of hydatid cysts with perchloride of mercury.

Though those who knew Philip Thornton Thane in his younger days and practised with him are no longer with us, we must remember that they and men of still earlier days laid the foundations of Australian medicine and are worthy of our grateful remembrance.

ERNEST ARTHUR D'OMBRAIN.

DR. ERNEST ARTHUR D'OMBRAIN, whose death was announced in these pages a few weeks ago, took an active interest for many years in scientific societies; he also gained recognition as one of the leading ophthalmologists of his day, for he knew his subject and was gifted with human understanding. For many years his health was far from good, but in spite of his disabilities he did not relinquish his work, but spent much of his time at the Medical Eye Service of New South Wales.

Ernest Arthur D'Ombraim was born at Rathdrum, County Wicklow, Ireland, and came to Australia when he was ten years old. He went to school in Victoria and studied medicine at the University of Melbourne, graduating as Bachelor of Medicine in 1894 and as Bachelor of Surgery in 1895. Later, after a period of study in England and Vienna, he returned to Australia and started practice in Sydney as an ophthalmologist. He joined the honorary staff of Sydney Hospital in the following year and served that institution until 1927, when he became honorary consulting

ophthalmic surgeon. He was a Foundation Fellow of the Royal Australasian College of Surgeons. He was also a Foundation Member of the Royal Australasian Ornithologists' Union. He was a member of the Wild Life Preservation Society of New South Wales and of the Linnean Society of New South Wales. For many years he was associated with the Royal Zoological Society of New South Wales and was a member of its council from 1917 to 1931, being elected subsequently as an honorary member. He was married twice. Dr. Arthur D'Ombraim, of Newcastle, is a son of the first marriage. His second wife survives him and there are two daughters. Much sympathy has been extended to them.

#### RICHARD POWELL WAUGH FRANCIS.

We regret to announce the death of Dr. Richard Powell Waugh Francis, which occurred on November 7, 1944, at Sydney.

### Post-Graduate Work.

#### THE NEW SOUTH WALES POST-GRADUATE COMMITTEE IN MEDICINE.

THE New South Wales Post-Graduate Committee in Medicine desires to announce that its offices are now situated at 131, Macquarie Street, Sydney, Telephone B 4606.

### Notice.

THE Editor is anxious to complete his copy of *The Australian Medical Journal*, Volume XV, 1910. At present two numbers are missing—number 4 (April 20, 1910) and number 8 (August 20, 1910). Any reader who had these two numbers and would be willing to part with them is asked to be good enough to communicate with the Editor at the journal office.

### Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

- Dowling, John Maxwell, M.B., B.S., 1943 (Univ. Sydney), Mater Misericordiae Hospital, Crow's Nest.  
 Maloney, Errold Frederick Grant, M.B., B.S., 1939 (Univ. Sydney), 26, Mabel Street, Willoughby.  
 Hall-Johnston, John, M.B., B.S., 1937 (Univ. Sydney), Squadron-Leader J. Hall-Johnston, Group 675, R.A.A.F., Pacific.  
 Mackintosh, Glencairn, M.B., 1938 (Univ. Sydney), Flat 7, "Edgewater", 2, Wulworra Avenue, Cremorne.  
 Wherrett, Leslie Albert, M.B., B.S., 1942 (Univ. Sydney), 1 Australian Water Ambulance Convoy, R.A.E., Australia.

### Books Received.

"Economy in the Use of Drugs in War-Time", Medical Research Council War Memorandum Number 3; Revised Second Edition; 1944. 8½" x 6", pp. 16. Price: 3d. net.

"Endocrine Man: A Study in the Surgery of Sex", by L. R. Broster, O.B.E., D.M., M.Ch. (Oxon.), F.R.C.S., Hon. F.A.S.A., with a foreword by Sir Peter Chalmers Mitchell, C.B.E., D.Sc., F.R.S.; 1944. London: William Heinemann Medical Books Limited. 8½" x 5½", pp. 155. Price: 12s. 6d. net.

"Rebel without a Cause: The Hypoanalysis of a Criminal Psychopath", by Robert M. Lindner, Ph.D., with an introduction by Sheldon Glueck, LL.B., Ph.D., and Eleanor T. Glueck, Ed.D.; 1944. New York: Grune and Stratton. 8" x 5½", pp. 310. Price: \$4.00.

"Treasury of Science", edited by Larlow Shapley, Samuel Rapport and Helen Wright, with an introduction by Dr. Shapley; Fourth Edition; 1944. New York and London: Harper and Brothers; Sydney: Angus and Robertson, Limited. 8½" x 6", pp. 727. Price: 25s.

### Diary for the Month.

- Nov. 21.—New South Wales Branch, B.M.A.: Medical Politics Committee.  
 Nov. 22.—Victorian Branch, B.M.A.: Council Meeting.  
 Nov. 23.—New South Wales Branch, B.M.A.: Clinical Meeting.  
 Nov. 24.—Queensland Branch, B.M.A.: Council Meeting.  
 Nov. 28.—New South Wales Branch, B.M.A.: Ethics Committee.  
 Nov. 30.—New South Wales Branch, B.M.A.: Branch Meeting.  
 Nov. 30.—South Australian Branch, B.M.A.: Scientific Meeting.  
 Dec. 5.—New South Wales Branch, B.M.A.: Executive and Finance Committee.  
 Dec. 5.—New South Wales Branch, B.M.A.: Organization and Science Committee.  
 Dec. 6.—Western Australian Branch, B.M.A.: Council Meeting.  
 Dec. 6.—Victorian Branch, B.M.A.: Branch Meeting.  
 Dec. 6.—Victorian Branch, B.M.A.: Council Meeting.  
 Dec. 7.—South Australian Branch, B.M.A.: Council Meeting.  
 Dec. 7.—New South Wales Branch, B.M.A.: Special Groups Committee.  
 Dec. 11.—Victorian Branch, B.M.A.: Executive Meeting.  
 Dec. 12.—Tasmanian Branch, B.M.A.: Branch Meeting.  
 Dec. 12.—New South Wales Branch, B.M.A.: Medical Politics Committee.  
 Dec. 15.—Queensland Branch, B.M.A.: Annual Meeting.

### Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

**New South Wales Branch** (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phoenix Mutual Provident Society.

**Victorian Branch** (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

**Queensland Branch** (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

**South Australian Branch** (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

**Western Australian Branch** (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia.

### Editorial Notices.

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